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1. Acknowledgements

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Shaun Henderson  Masonite  Johan Nel  TWK
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2. Counterfeit tools and machines

The import of counterfeit equipment has increased recently. These products not only compromise the original products in terms of their trade mark, but fail to meet the standards of recognised industry safety and structural design qualities present in the original machines.

It is important to note that:

» Counterfeit is not just a copy;
» Counterfeiting include ‘un-branded’ products intended for re-branding;
» Counterfeits can at times include an element of fraud even if buyers are aware the product is fake;
» Counterfeits lead to poor quality and a potentially hazardous product;
» Counterfeits can lead to consumer distrust in a recognised brand;
» An estimate of 3-7% of the value of world trade is counterfeit and is increasing;
» Counterfeits damages legitimate businesses on all levels – in terms of brand owners, manufacturers, distributors and dealers in terms of loss of sales and loss of value in the brand.
3. Purpose of the handbook

The South African outdoor power equipment safety and operating handbook covers all aspects relating to the safe operation of outdoor power equipment, ensuring the user understands the reason for certain mechanical and dynamic principles and reactive forces that exist in machinery of this kind.

This handbook has been written for South African forestry operations and conditions. The handbook is aimed at making operations using outdoor power equipment more efficient and safer, especially since the realm in which this outdoor power equipment is being used is expanding from relatively little use in the past. Equipment like this can also be used for work in applications that are different from its original design framework.

The Handbook has been designed to standardise outdoor power equipment handling requirements. It is therefore a convenient reference and guide to effective and safe working procedures. All machine operators, instructors, training centres, tertiary education institutions, forestry company management, forest owners, maintenance facilitators and distributors should refer to this handbook for operational guidance.


The Handbook is generic by nature and does not replace the outdoor power equipment owner’s manual, which is specific to a particular make and model.

This Handbook can be referred to in the development of training material generated for small plant operators. It is therefore a useful tool for designing training courses and assessment guides and to complement work and safety procedures for companies and institutions.

Due to the dynamic changes in forestry operations, many of the tools and applications detailed in this handbook are evolving and being refined. Appropriate updates and changes will be published and distributed.

Training institutions

It is recommended using certified training institutions that comply with industry standards (i.e. Forestry Industry Training Provider Association, FITPA) and specific training criteria. It is important to check that institutions comply with industry and company specific requirements.

Throughout this handbook general warnings will appear in red boxes

WARNING:
• Be aware of the kickback zone on the saw;
• Always maintain a 15m safety distance.

and important points in blue boxes.

IMPORTANT:
Always switch off the engine and stop the saw before handling or inspecting the blade.
4. Statutory Requirements

The duties and obligations of the employer and employees required through the Occupational Health and Safety Act (Act 85 of 1993) Section 8 are detailed as follows:

4.1. General duties of employers

According to the Occupational Health and Safety Act (Act 85 of 1993) Section 8, the general duties of employers to their employees are as follows:

1. Every employer shall provide and maintain, as far as is reasonably practical, a working environment that is safe and without risk to the health of his employees.

2. Without derogating from the generality of an employer’s duties under subsection (1), the matters to which those duties refer include in particular:
   a. The provision and maintenance of systems of work, plant and machinery that, as far as is reasonably practicable, are safe and without risks to health;
   b. Taking such steps as may be reasonably practicable to eliminate or mitigate any hazard or potential hazard to the safety or health of employees, before resorting to personal protective equipment;
   c. Making arrangements for ensuring, as far as is reasonably practicable, the safety and absence of risks to health in connection with the production, processing, use, handling, storage or transport of articles or substances;
   d. Establishing, as far as is reasonably practicable, what hazards to the health or safety of persons are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used in his business, and he shall, as far as is reasonably practicable, further establish what precautionary measures should be taken with respect to such work, article, substance, plant or machinery in order to protect the health and safety of persons, and he shall provide the necessary means to apply such precautionary measures;
   e. Providing such information, instructions, training and supervision as may be necessary to ensure, as far as is reasonably practicable, the health and safety at work of his employees;
   f. As far as is reasonably practicable, not permitting any employee to do any work or to produce, process, use, handle, store or transport any article or substance or to operate any plant or machinery, unless the precautionary measures contemplated in paragraphs (b) and (d), or any other precautionary measures which may be prescribed, have been taken;
   g. Taking all necessary measures to ensure that the requirements of this Act are complied with by every person in his employment or on premises under his control where plant or machinery is used;
   h. Enforcing such measures as may be necessary in the interest of health and safety;
   i. Ensuring that work is performed and that plant or machinery is used under the general supervision of a person trained to understand the hazards associated with it and who has the authority to ensure that precautionary measures taken by the employer are implemented; and
   j. Causing all employees to be informed regarding the scope of their authority as contemplated in Section 37(1) (b).


4.2. **General duties of employees**

According to the *Occupational Health and Safety Act (Act 85 of 1993) Section 14*, the general duties of employees at work are as follows:

a. Take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions;

b. As regards any duty or requirement imposed on his employer or any other person by this Act, co-operate with such employer or person to enable that duty or requirement to be performed or complied with;

c. Carry out any lawful order given to him, and obey the health and safety rules and procedures laid down by his employer or by anyone authorised thereto by his employer, in the interest of health or safety;

d. If any situation which is unsafe or unhealthy comes to his attention, as soon as practicable report such situation to his employer or to his health and safety representative for his workplace or section thereof, as the case may be, who shall report it to the employer; and

e. If he is involved in any incident which may affect his health or which has caused an injury to himself, report such incident to his employer or to anyone authorised thereto by the employer, or to his health and safety representative, as soon as practicable but not later than the end of the particular shift during which the incident occurred, unless the circumstances were such that the reporting of the incident was not possible, in which case he shall report the incident as soon as practicable thereafter.
5. Health hazards, safe equipment operation requirements and personal protective equipment (PPE)

This chapter describes the major health hazards associated with outdoor power equipment use. The operator must be aware of the following:

5.1. Health hazards

Health hazards are those that affect the operator directly and can cause immediate, progressive or long term damage to human health.

5.1.1. Exhaust fumes

Exhaust fumes contain carbon monoxide which can cause drowsiness and a lack of concentration, thereby increasing the risk of an accident. For equipment powered by internal combustion engines, the muffler has been designed to direct exhaust fumes away from the operator, thus reducing the risk.

To minimise this hazard adhere to the following:

» Maintain the muffler in good condition (if fitted);
» Ensure the power tool is properly tuned and maintained;
» Do not work in confined and enclosed spaces.

5.1.2. Machine vibration

High frequency vibration transmitted from some of the outdoor power equipment discussed in this handbook to the hand of the operator can affect the tactile sense of the hand and fingers. This phenomenon is known as Vibration Induced White Finger Disease (VWF). It is caused by a reduced flow of blood to the finger extremities which is similar to the symptoms of Raynaud’s disease (Pyykkö et al, 1978). Excessive vibration can increase the likelihood of this disease, especially in cold climates.

To minimise the risk of VWF adhere to the following:

» Ensure the outdoor power equipment is properly tuned and maintained;
» Regularly check the effectiveness of the anti-vibration system;
» Wear gloves/mitts;
» Do not operate equipment when excessive vibration is experienced.
5.1.3. Potential hearing loss

Noise louder than 85dB (A) can cause permanent hearing loss. The noise generated by some of the outdoor power equipment used in forestry applications exceeds 85dB (A) and can therefore start to damage hearing after just a few minutes of exposure (Table 2-1).

The damage caused by noise depends on the loudness and the length of exposure. Refer to Table 2-1 for noise levels to which a person can be exposed to per day without the likelihood of hearing damage. Also refer to the noise induced hearing loss regulations as published in the OSH Act 85/93.

Table 2-1: Maximum daily exposure to noise levels. (Occupational Safety and Health Service, 1995 & FESA, 1998.)

<table>
<thead>
<tr>
<th>Noise Level</th>
<th>Maximum daily exposure</th>
<th>Description</th>
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<tbody>
<tr>
<td>85dB(A)</td>
<td>8 hrs</td>
<td>Acceptable noise level</td>
</tr>
<tr>
<td>88 dB(A)</td>
<td>4 hrs</td>
<td>Noise levels found inside open cab forestry equipment.</td>
</tr>
<tr>
<td>91 dB(A)</td>
<td>2 hrs</td>
<td></td>
</tr>
<tr>
<td>94 dB(A)</td>
<td>1 hrs</td>
<td></td>
</tr>
<tr>
<td>97 dB(A)</td>
<td>30 min</td>
<td>Noise levels generally found in the proximity of high revving logging machinery.</td>
</tr>
<tr>
<td>100 dB(A)</td>
<td>15 min</td>
<td></td>
</tr>
<tr>
<td>103 dB(A)</td>
<td>8 min</td>
<td></td>
</tr>
<tr>
<td>106 dB(A)</td>
<td>4 min</td>
<td>Levels to which operators of petrol driven chainsaws are exposed to.</td>
</tr>
<tr>
<td>109 dB(A)</td>
<td>2 min</td>
<td></td>
</tr>
<tr>
<td>112 dB(A)</td>
<td>1 min</td>
<td></td>
</tr>
<tr>
<td>115 dB(A)</td>
<td>20 sec</td>
<td></td>
</tr>
</tbody>
</table>

Operators and other people in the proximity of the working outdoor power equipment should not exceed the exposure time stated in the above table without wearing appropriate hearing protection.

To minimise the risk of hearing loss adhere to the following:

» All operators and workers in their proximity must wear adequate hearing protection;

» Ensure that a serviceable muffler, complying with the manufacturer’s specifications, is fitted (where required);

» Ensure the outdoor power equipment is properly tuned, maintained and that all its components are fitted.

5.1.4. Musculo-skeletal injuries

Musculo-skeletal injuries concern primarily the lower back, but the neck, shoulders, upper arms, hips and knees could also be affected. To minimise the risk of musculo-skeletal injuries, ergonomically established working methods and postures must be adhered to. Wearing a well fitted harness can also minimise the risk of musculo-skeletal injuries when using outdoor power equipment that requires the use of these harnesses.
5.1.5. **Cuts, bruises and abrasions**

Due to the nature of the work environment, cuts, abrasions and bruises are common. In order to minimise the risk operators should be made aware of the risk and be cognisant how their actions can cause these personal injuries. Operations should always have stocked first aid kits available to deal with these issues should they occur.

5.1.6. **Chemical use and application of chemicals in forestry operations**

This handbook covers equipment that can be used for the application of chemicals (mist blowers and powered chemical knapsacks). For this reason, certain legislative requirements should be adhered to, as per Hazardous Chemical Substances Regulations in the **OHS Act 85/93**.

It is important to always ensure that the **minimum required PPE** is worn according to the particular chemical material safety data sheet (MSDS) and **SANS standard 10206-2010**.

The particular machine sections will highlight suggestions for particular PPE needed for general operating conditions.

5.2. **Safe equipment operation requirements**

Safe use of outdoor power equipment not only increase the life of the equipment but also reduces the risk to the operator’s health and safety. The operator should be aware of the following:

5.2.1. **General safety requirements**

Regardless of the type of operation the operator of the outdoor power equipment discussed in this handbook must adhere to the following general safety requirements:

» Do not operate any equipment if not properly trained;

» Trainee operators may only operate under direct supervision of a competent person;

» Do not attempt tasks not trained for;

» Use only safe working methods and techniques as stipulated in this Handbook or official equipment operating manuals;

» Follow all safety requirements as stipulated in this Handbook;

» Use outdoor power equipment suitable for the task at hand;

» Do not modify the outdoor power equipment from its original design without the manufacturer’s permission;

» Use a serviceable, properly maintained outdoor power tool;

» Use outdoor power equipment that are fitted with serviceable safety devices;

» Wear the required personal protective equipment;

» Do not operate outdoor power equipment in unsafe conditions (e.g. high winds, snow, heavy rain or poor visibility);
Do not work alone when operating outdoor power equipment, maintain contact with other workers at a safe distance;

» Do not operate outdoor power equipment when fatigued;

» Do not operate outdoor power equipment when under the influence of drugs and/or alcohol;

» Do not cut any material other than wood or plant material;

» Be aware of other workers and equipment in the proximity of the work area;

» Ensure that the outdoor power equipment is properly held, footing is stable and the correct working position is used;

» Be aware of reactive forces. (See applicable outdoor power equipment chapters for a more detailed discussion);

» Be aware of slips and falls;

» Be aware of public access roads or paths where cycling or other sports are popular;

» Follow all instructions as per operator’s manual.

5.2.2. Safe transport of machinery

It is important to ensure that all equipment, fuel (if applicable) and chemical (if applicable) is safely stored and secured when transported in a vehicle to and from the work site. Also ensure that the outdoor power equipment, fuel (if applicable) and chemical (if applicable) is transported separately from operators for comfort and safety.

5.2.3. Safe disposal of batteries

If the equipment is battery powered, ensure that batteries that have reached the end of their useful life are disposed of in a responsible manner, according to legislative and manufacturer guidelines.

5.3. PPE safety

Personal protective equipment (PPE) must be worn at all times whilst working with outdoor power equipment. According to Section 38 of the OHS Act (85 of 1993), the law specifies that the employer shall provide “adequate” protection, free of charge. Clothing must be sturdy and snug-fitting, but allow complete freedom of movement. Avoid using loose fitting clothing. It is advisable that operators wear highly visible shirts as this will assist in locating them.

For operations where assistants are used, they are required to comply with the same requirements as applicable to the outdoor power equipment operator. When in doubt please refer back to the manufacturers and industry / company specific standards for the appropriate PPE.

PPE also degrades and needs to be worn in a particular way, please ensure labour and operations comply with the following guidelines, in terms of requirement and replacement guidelines.
5.3.1. The use of safety helmets

Safety helmets are in most cases required to be worn when working in the forestry work environment. However, certain considerations need to be taken into account.

5.3.1.1. Design and safety specifications

Safety helmets are designed to provide protection against falling objects as well as attachment points for earmuffs and visors.

Adhere to the following:
- Use only SABS (SANS 1397 standard) (EN 397 standard) approved safety helmets;
- Replace safety helmets as per manufacturer's instructions.
- Do not modify safety helmets from their original design as it will reduce their strength (i.e. no stickers, permanent markers, cutting etc.);
- Check suspension systems frequently;
- Use safety helmets of a highly visible colour.

5.3.1.2. Replacement of safety helmets

Replace safety helmets as per manufacturer's instructions (5 years after date of manufacture or 3 years after purchase). Figure 2-1 is read with the number in the centre being the year (2010) and the arrow pointing to the month of manufacture (February);

Figure 2-1: Manufacture date indication on hard hats.

5.3.2. Hearing protection

Hearing damage caused by exposure to continuous loud noise can be reduced by using hearing protection. Earmuffs or earplugs can be used. Earmuffs are preferred due to the fact that superior hearing protection is offered as well as increased comfort and better hygiene.

Adhere to the following:
- Use only hearing protection that reduces noise levels to below 85dB (A). It is recommended that hearing protection complying with EN352-3:1995 standard is used;
- Clean and maintain according to manufacturer's instructions;
- Replace when damaged or as per manufacturer's instructions;
- Operator not to wear anything on the head that does not allow the helmet or the hearing protection to fit properly (Figure 5-2).
Figure 5-2: (a) Improper use of headwear under helmet, (b) correct use of chainsaw headwear and (c) damaged earmuffs

Source: Gen James 2013
5.3.3. *Eye protection*

Eye protection should be used at all times with certain machinery. ‘Combi-helmets’ for this purpose are fitted with visors that must be in serviceable condition, and in some cases can be complimented with safety glasses. Further recommendations follow in the individual equipment sections.

When choosing eye protection adhere to the following:

- Use only [EN 1731](#) standard approved visors;
- Replace when damaged or as per manufacturer’s instructions;
- Maintain and clean when required.

5.3.4. *Foot protection*

Due to the nature of operations where outdoor power equipment will be used, sturdy steel toe cap boots with midsole and ankle protection should be worn by all operators. These boots should comply with the relevant company specific industry standards.

5.4. *Fitting a machine harness properly*

Ensuring the correct fitting of a machine harness, if needed, ensures safe and ergonomic operation. Follow the steps detailed below as a guide to do so (some harnesses may differ slightly, put the principles remain the same):
Step 1: Hip Belt. Fit the harness level with the top of your hip bone and tighten firmly.

Step 2: Shoulder straps. Adjust the shoulder straps so that the chest strap sits by your sternum.

Step 3: Side straps. Adjust the side straps so that the chest plate is centred on your chest.

Step 4: Shoulder straps and hip pad. Adjust the shoulder straps so that the load on the hip pad is spread evenly over the shoulders. Make sure the hip pad hook is about 10-15cm below the edge of the hip bone (see hand and fingers).

5: Rubber back straps (manufacturer dependent). The back strap can be adjusted to move weight distribution between shoulders and hip belt.

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6. Outdoor power equipment and machine applications

The machines defined as outdoor power equipment include the following:

» Clearing saws;
» Brush cutters;
» Earth augers;
» Pruning equipment:
  • Pole pruners;
  • Electric shears and loppers.
» Powered chemical knapsacks;
» Fire suppression blowers;
» Mist blowers (chemical application).

The above mentioned outdoor power equipment can be used in the following applications (Table 6-1):

Table 6-1: Application of outdoor power equipment in forestry situations

<table>
<thead>
<tr>
<th>Forestry operations</th>
<th>Outdoor power equipment</th>
<th>Clearing saw</th>
<th>Brush cutter</th>
<th>Earth Auger</th>
<th>Pole pruner</th>
<th>Electric shears / loppers</th>
<th>Mist blowers</th>
<th>Fire suppression blowers</th>
<th>Powered knapsacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coppice reduction</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>[:]</td>
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<td></td>
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<tr>
<td>Pruning</td>
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<tr>
<td>Mech. weeding</td>
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<td>✓</td>
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<td></td>
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<td>✓</td>
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<tr>
<td>Chem. weeding</td>
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<td>✓</td>
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<td>✓</td>
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<tr>
<td>Felling to waste</td>
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<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fire suppression</td>
<td></td>
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<td></td>
<td></td>
<td>✓ (Limited)</td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td>Fire-break prep./clearing</td>
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<td>✓</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Brush cutting</td>
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<td></td>
<td></td>
<td>✓</td>
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<tr>
<td>Hole drilling</td>
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<td>✓</td>
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<td></td>
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<tr>
<td>Plant/pit preparation</td>
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<td></td>
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<td>✓</td>
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</tbody>
</table>

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7. The use of machinery not intended for a particular application, mulchers, brush cutters and clearing saws

Although some of the machinery discussed in this handbook was not particularly designed for use in forestry and agricultural applications by the OEM, the machine has been designed to be used with particular attachments. The swapping of attachments, or design of ‘new’ or ‘improved’ attachments which are not endorsed by the original machine manufacturer is not recommended.

The swapping of attachments is particularly evident in interchanging cutting attachments used on clearing saws to brush cutters. Brush cutters are not intended to be used in the applications that clearing saws are used and vice versa. Clearing saw and brush cutters differ from each other in terms of their application, robustness and design. It is important not to confuse the design of the two types of machine, this is illustrated in Figure 7-1.

![Figure 7-1: Difference in design between (left to right) mulcher, brush cutter and clearing saw](image-url)
8. Clearing saws

Clearing saws are outdoor power equipment used for cutting woody vegetation for the majority of the time they are operational. The unit comprises of a saw blade that is attached to a drive shaft and powered by a motor through gearing inside the casing of the shaft.

8.1 External components

The clearing saw includes the following components (Figure 8-1).

![Figure 8-1: External components of a clearing saw.](image)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Locking nut</td>
</tr>
<tr>
<td>2</td>
<td>Bevel gear</td>
</tr>
<tr>
<td>3</td>
<td>Grease filler cap and bevel gear</td>
</tr>
<tr>
<td>4</td>
<td>Shaft</td>
</tr>
<tr>
<td>6</td>
<td>Throttle lock</td>
</tr>
<tr>
<td>7</td>
<td>Stop switch</td>
</tr>
<tr>
<td>8</td>
<td>Throttle trigger lockout</td>
</tr>
<tr>
<td>9</td>
<td>Handle adjustment</td>
</tr>
<tr>
<td>10</td>
<td>Support eyes for harness</td>
</tr>
<tr>
<td>11</td>
<td>Support flange</td>
</tr>
<tr>
<td>13</td>
<td>Carburettor screwdriver</td>
</tr>
<tr>
<td>14</td>
<td>Socket spanner</td>
</tr>
<tr>
<td>15</td>
<td>Harness</td>
</tr>
<tr>
<td>16</td>
<td>Allen key</td>
</tr>
</tbody>
</table>

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8.1.1 Clearing saw design
Clearing saws are designed to be held and supported by a harness attached to the operator for ergonomic and safe use (Figure 8-2).

Figure 8-2: Working stance of a correctly set-up clearing saw

8.1.2 Clearing saw harness
For ergonomic safe use, ensure that the clearing saw harness is set up properly. Follow the steps detailed in Section 5.4.
8.1.3  Clearing saw set up

The set up of a clearing saw should be done in the following way:

**Suspension ring:** Adjust and fasten the ring so that the handle bars are horizontal when the unit is hanging freely.

**Distance above the ground:** Make sure the saw blade is 20-30cm above the ground when hanging freely.

**Adjust the handles:** Make sure that the wrist is straight and the angle of your elbow is approximately 120°. The handlebars should also be adjusted so that they are right in front of the arms.
8.2 **Personal protective equipment**

Due to the clearing saw being used to cut vegetation and utilising a rotating saw to do so, PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an accident.

8.2.1 **Safety helmet**

A clearing saw helmet with ear protection and visor are required at a minimum, some organisations may require additional eye protection. The specifics of the safety helmet are found in Section 5.3.1.

8.2.2 **Eye protection**

It is important that the operator wears eye protection that is at a minimum a visor usually as a part of the combination safety helmet. These visors are designed to deflect or stop small particles such as wood chips, however, the visor will not completely prevent fine particles from penetrating the eye. In some cases, health and safety guidelines may recommend the use of safety glasses to prevent this. Details of minimum requirements for eye protection are found in Section 5.3.3.

8.2.3 **Hearing protection**

Hearing protection is usually attached to the safety helmet. Ensure that the hearing protection complies to guidelines in Chapter 5.3.2.

8.2.4 **Gloves/mitts**

Sturdy tight fitting gloves with a wrist strap should be worn, giving the operator a good feel and grip on the handlebars. These should preferably be made of leather. Ensure that the gloves are replaced when worn or as per manufacturers specifications.

8.2.5 **Leg protection**

Strong durable trousers should be worn as a minimum, with shin protectors as an optional recommended extra, in some cases a vinyl/plastic apron can also be worn.

8.2.6 **Footwear**

Appropriate safety boots with adequate steel toe protection to provide protection against the running saw blade and rolling logs and rocks should be used. It is recommended to use footwear complying with **EN ISO 20345:2004** standard that are cut resistant. These boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support and an adequate level of cut resistance. Lace-up types must be securely fastened to prevent tripping over laces.
8.3 Other accessories and tools required

The clearing saw operator should be equipped with the following:

> Files to sharpen the blade (file and file guide);
> A suitable harness to fasten the saw to the operators body;
> Spanner or spark plug and screw driver combination spanner to tighten nuts and bolts on the unit and a screwdriver;
> Tools to change the blade;
> A suitable container for fuel, with a non-spill spout;
> Cloth/brush for cleaning the clearing saw;
> Whistle to be carried for emergencies;
> Spare blades, blade key and locking key for bevel gear.

The following equipment and tools should be available on site:

> First aid kit in close proximity;
> Radio or mobile phone for emergency contacts;
> Fire extinguisher.

8.4 Carrying and moving the unit

When moving the saw long distances or transporting the saw, always ensure the unit is off and an appropriate transport guard is fitted to the cutting attachment.

8.5 Before using the unit

Before using the unit make sure the following checks are done:

8.5.1 Pre-start safety checks

Ensure that the appropriate safety checks are done prior to operating the unit. These include:

> Check for cracks in the blade or cutting attachment or the support flange. If cracks are found, discard the blade or cutting attachment;
> Ensure the lock nut is firmly tightened, discard the lock nut according to manufacturer’s specifications as the nylon locking ring in the nut has a limited lifespan (usually after 10 tightens/uses – as per OEM specifications);
> Check the cutting attachment guard is not damaged, do not use a machine if the guard is damaged;
> Make sure the throttle control and the shut-off switch are functioning, make special note that the throttle lockout is working;
> Ensure the fuel cap is tightened;
> Ensure that no fuel has been spilled onto the machine while refuelling
> Check the harness is sitting properly and that the safety release works.
Once started check:
» Check the attachment doesn’t rotate when idling and;
» The silencer works and the spark arrestor is not blocked.

8.5.2 Starting

The machine can be started ‘cold’ first thing in the day or after a long break or ‘warm’ when the engine has been off for a short time.

Cold start procedure is:
» Turn the switch to the ‘start’ position;
» Put the choke control in the choke position;
» Squeeze the primer fuel pump bulb (Figure 8-3) (the bulb doesn’t need to completely fill).

Warm start procedure is to follow the same procedure as a cold start, except do not choke the machine.

To start the machine:
» Make sure no one is in the working area (safety distance of 15m);
» Place the machine on the ground so that the blade is clear of the ground and other objects (Figure 8-4);
» Grab the started handle with your right hand and pull the cord until you feel some resistance, then pull the cord with a vigorous motion;
» If a cold start, turn off the choke once the engine fires and pull the starter cord to start the machine;

Figure 8-3: Priming the fuel for the engine
» Give the machine full throttle (the start throttle shuts off automatically);
» To stop the engine use the engine stop switch.

Figure 8-4: Starting the saw on the ground

IMPORTANT:
• Never wrap the starter cord around your hand;
• Do not pull the cord all the way out and do not let go of the start handle when pulled all the way out. This will damage the starter mechanism.

8.5.3 Refuelling

The following procedure should be followed when refuelling a clearing saw:
» Use a fuel container with overflow protection to avoid spills (non-spill spout) (Figure 8-5 a and b);
» Wipe the fuel cap clean to prevent contamination of the fuel in the tank;
» Open the fuel cap carefully;
» Shake the fuel in the fuel container to ensure a proper mix of oil and fuel;
» Close the fuel cap carefully;
» Start the machine at least 3m away from refuelling area for safety.
8.6 Using the unit

It is important to understand some basic principles of working with clearing saws, namely the reactive forces, directional felling and good operating technique.

8.6.1 Reactive forces on clearing saw

Like a chainsaw, the clearing saw experiences similar reactive forces such as kickback. These reactive forces are dependent on the size of the material (tree) being cut. By describing the blade as a clock one can identify the danger areas when cutting, 6 o’clock would therefore be the part of the blade that is closest to the operator when the saw is hanging from the harness.

General rules when using a clearing saw include:

- Cutting small trunks (0-3cm): generally, the whole blade can be used without experiencing kickback.
- Cutting larger trunks (>3cm): care must be taken when cutting trunks larger than 3cm. In these cases the area between 12 and 3 o’clock should be seen as a kickback zone (Figure 8-6 a). When this part is put against the side of a trunk, there is a great risk that the saw will be thrown to the right.

Figure 8-5: Clearing saw fuel canister with tools and spare blades

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Figure 8-6: Saw blade zones (a) the kickback zone between 12 and 3 o’clock when sawing stems thicker than 3cm (b) safer zones giving different levels of control – the zone between 8 and 12 o’clock gives full control and greater precision and the zone between 3 and 5 o’clock enables rapid cutting but less precision

**WARNING:**
- Be aware of the kickback zone on the saw;
- Always maintain a 15m safety distance.

Control when cutting: better accuracy and control of the object being cut can be achieved. When cutting with section 8 to 12 o’clock sawing can be done with great control and good precision. The section between 3 and 5 o’clock will saw through the tree quickly but the precision will not be as good due to the saw digging into the wood (Figure 8-7 b).

### 8.6.2 Directional felling with a clearing saw

Understanding where a tree will fall when sawing with a clearing saw ensures safe and efficient operation. In order to ensure the tree falls in a particular direction, the operator can use the flowing:

- The blades rotation (Figure 8-7) - if you use the right hand side of the blade (3-5 o’clock) the blade will push the base of the stem away from you and the tree towards you. Similarly if you use the left-hand side of the blade (8-12 o’clock) the blade will push the base towards you and the tree will fall forwards away from you;
The angle of the blade determines the angle of the cut and therefore the direction of the tree falling. (Figure 8-8);

Figure 8-8: The angle of the cutting blade influencing the felling direction of the tree; (a) cutting an angle to the right and the tree falling to the left and (b) cutting an angle to the left and the tree falling to the right
Direction of the approach - if you push the base of a tree in a particular direction it will fall in the opposite direction.

The stump height - the higher the stump the easier to control the direction before the tree strikes the ground. High stumps are however often not desired in forestry clearing operations and may re-sprout.

Environmental conditions like lean of the tree and wind can also play a role.

### 8.6.3 Good operating technique for a clearing saw and mulcher

The correct operating technique ensures safe and productive operating. A good technique for effective operating includes the following:

- Always have the saw at full throttle before cutting the stem. The saw will not get stuck and with more control over the cut, the saw will also be able to cut bigger trunks;
- Always release the throttle once the saw has cut through the stem to prevent debris like branches being caught between the blade and the blade guard;
- If debris gets stuck between the blade and the blade guard, stop the machine and push the blade counter clockwise against another tree.

### 8.7 Felling techniques for a clearing saw

#### 8.7.1 Normal felling of small woody weeds and small trunk trees (0-3cm)

Felling trees of a small diameter can often be done in a sweeping motion ([Figure 8-9](#)). Trees of this size can be cut through in one cut. This technique can cut multiple stems at once. There is no need to be concerned about kickback in small trees and both sides of the blade can be used to cut the trees.

![Figure 8-9: The sweeping method used to cut small diameter vegetation](#)
8.7.2 Normal felling of larger trees with a single cut (3-8cm)

When felling larger trees of this size it is important to understand the right technique to be employed to ensure productive and safe operating. By using the techniques in Chapter 8.6.2, trees will fall in the most desired place. The operator must be aware of kickback in these tree sizes. Trees can be felled in the following ways:

Felling to the left, angled back towards the operator: Angle the blade down to the right. Saw at 4 o’clock on the blade. Saw through and push to the right.

Felling to the right, angled back towards the operator: Angle the blade down to the left. Saw at 4 o’clock on the blade. Saw through.
Felling to the left, angled away from the operator: Angle the blade down to the right. Saw at 9 o’clock on the blade, saw through and with a distinct motion, pull the blade to the right until the tree falls. This way the operator avoids having the trunk land on the blade and the risk of sawing into the ground.

Felling to the right, angled away from the operator: Angle the blade down to the left. Saw at 9 o’clock on the blade. Saw through and keep pushing to the left.
8.7.3 Normal felling of large trees with two cuts (8-15cm)

Trees with a larger diameter require more than one cut to fell and require care to avoid kickback. Simple felling requires one cut to be made on either side of the tree to fell it, these techniques are described in more detail as follows:

**Felling forward:** Hold the blade horizontal. Saw at 8 o'clock on the blade. Saw through the trunk and pull the saw towards you.

**Felling to the side:** Hold the blade horizontal. Saw at 3 o'clock on the blade, cutting slightly more than halfway through the trunk. Extract the blade from the groove and start sawing on the other side of the tree, a bit higher up, at 9 o'clock. Saw slightly more than half way through the trunk. If necessary, push the trunk with your left hand.
Felling forward: Hold the blade horizontal. Saw at 5 o’clock on the blade, cutting half way through the trunk. Extract the blade from the groove, take one step to the left and start sawing on the other side, at 10 o’clock on the blade. Leave some wood in the direction you want the tree to fall, to guide the tree as it falls. Push the tree with your left hand and if necessary saw off the remaining wood.

Felling backwards: Hold the blade horizontal. Saw at 5 o’clock on the blade, cutting half way through the trunk. Extract the blade from the groove, take one step to the right and start sawing on the other side, at 8 o’clock on the blade. Leave some wood in the direction you want the tree to fall as a guide as it drops. Pull the tree down with your left hand and if necessary saw off the remaining wood.
8.7.4  **Felling special case trees (>15cm)**  

Clearing saws are not designed to fell very large trees due to the diameter of the blade being only 18cm. When felling trees of this size you can use an open directional notch in the direction of the lean of the tree. The following procedure should be followed (Figure 8-10):

» Clear the area where the tree will fall;

» Start with a horizontal top cut on the side to which the tree is supposed to fall, using a part of the blade that gives the most control;

» Saw an undercut that joins the previous cut to form a wedge to guide the fall of the tree;

» On the opposite side of the tree make the felling cut using section 8 to 12 o’clock on the blade;

» Leave some timber in the form of a wedge to help guide the felling and control the direction.

![Figure 8-10: Felling larger diameter trees](image)

8.7.5  **Felling tree clusters**

Felling trees in a cluster or tree coppice requires the following technique:

» Clear around the cluster, where the trees will fall;
- Start by sawing the trees high around the edge of the cluster;
- Cut these stumps lower;
- Reach into the centre of the cluster with the blade to saw these stems;
- If there is difficulty reaching these stems, cut them higher (as before) to ease felling and prevent the blade being pinched undercut stems.
8.7.6 Clearing saws for coppice reduction

Follow the same procedure as detailed in Section 8.7.5 but pay special attention to the following:

» It is preferable to perform this operation during the dormant period (winter) as the bark is less likely to tear and increase stump mortality;

» All remaining stems (per stump) must be clearly identified well in advance to the operation taking place;

» When reducing coppice on slopes, start on the lower slopes and work uphill allowing the cut stems to fall away from the work-face so that the working zone is left clear;

» Ensure the remaining stems are not damaged as this can serve as an entry point for disease as well as increased potential for wind throw;

» Apply the “de-throttle” technique when approaching the selected stems or when cutting very thin stems near selected stems;

» When reducing coppice the quality of the cut is important. Cuts should be clean with no separation of the bark from the stem during the cutting process;

» Stems must be cut as low as possible to reduce the effect of feathering;

» Stems are to be felled in the direction of the inter row and not across rows into the remaining stems.

8.8 Operating the unit productively

Work methodology and planning ensure that the unit will be used productively. Firstly, be aware of the following environmental conditions:

» **Slope:** Caution is to be exercised on steep slippery slopes. It is preferable to work up the slope where conditions are very steep.

» **Rocky areas:** Caution is to be exercised as there is a danger of hitting unseen rocks hidden in vegetation. Never allow the saw blade to come into contact with stones, rocks or the ground as this will immediately dull and potentially crack the saw blade.

» **Tree size:** It is not recommended to fell trees with a stem diameter larger than the radius of the cutting blade. Oversized trees need special care and training.

The operator should be aware of and practice the following:

» The correct equipment must always be selected for the task; this significantly reduces risk and improves productivity;

» Ensure sound footing and a stable posture;

» Change the direction of the strip when terrain becomes steeper and walk across the slope on the contour to reduce fatigue;

» To ensure directional felling, incline the saw blade in the opposite direction to the intended felling direction;

» Always maintain the intended felling direction to ensure that the felled stems do not fall onto the selected stems, resulting in either their damage or breaking of attachment points;

» Before engaging the cut, accelerate the engine to full throttle ensuring there are no obstacles in front of the attachment;

» **For clearing saws** the fell pattern is determined by the density of the canopy, wind direction and undergrowth. Where possible, move in a rearward direction (as per normal harvesting fell patterns), causing the felled stems to fall forwards, thereby facilitating ease of access and controlled placement of the brush piles;
» In compartments where undergrowth dictates otherwise, fell in a forward motion, ensuring at all times that the correct felling direction is maintained to facilitate access and placement of the brush piles;

» **For clearing saws** ensure that the correct portion of the saw blade is used and the tilt is positioned to facilitate the required felling direction.

» Delays should be avoided by ensuring the following:
  • Sufficient fuel and lubricant is available for the shift;
  • Plan refuelling so as to avoid walking long distances to refuel;
  • Spare sharp blades must be available if blades are sharpened at the workshop;
  • Where a team of clearing saws is working, allocate a clearly defined area to each operator to avoid walking long distances between rows.

» Ensure blades are sharpened regularly to ensure efficient cutting by following the given training procedure.

Important criteria when working with a clearing saw productively include the following (to be applied in the case of clearing saws and mulchers.)

**Selection:**

» Decide on trees to clear and which ones to leave per stop;

» Get into a work flow and decide which trees to remove and leave before you get to them;

» It is good practice to try and plan 2-3 moves ahead.

**Swaths:**

» To make your job as efficient as possible – work in straight line swaths (**Figure 8-11 a**);

» Choose the width of the swath depending on the work technique you are using (**Figure 8-11 b-c**).

<table>
<thead>
<tr>
<th>a)</th>
<th>b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For maximum efficiency work in swaths and in straight lines trying to clear equal strips at a time.</td>
<td>When felling to one side it is good technique to fell the trees into the area already cleared.</td>
</tr>
</tbody>
</table>
8.9 Attachments

Making sure the blade is well sharpened, set and not damaged ensures the clearing saw will operate to its optimum and not put strain on the equipment or the operator. A saw blade in Figure 8-12 is the only attachment recommended for this machine.

Figure 8-12: Clearing saw blade
8.10 Maintaining the blade of a clearing saw

It is good practice to inspect and sharpen the attachment as often as possible, preferably at every refuel. Always use (if applicable) a file mounted in a specifically designed file guide (Figure 8-13).

**IMPORTANT:**
- Always switch off the engine and stop the saw before handling or inspecting the blade.

![Clearing saw file, file guide and holder](image)

**Figure 8-13: Clearing saw file, file guide and holder**

8.10.1 Filing the clearing saw blade

The following procedure should be followed when filing the blade for sharpening:

» Support the machine so that the blade is secure and the operator’s arm can make smooth movements when filing. The blade should preferably be held in a vice (Figure 8-14).

![Sharpening the blade while holding the saw](image)

**Figure 8-14: Sharpening the blade while holding the saw.**
» Use a file guide and file the cutting teeth at 15° (**Figure 8-15**).

![Figure 8-15: File angle at 15° and the file at 90° to the plane of the blade.](image1)

» Make sure the whole file guide rests firmly on the tooth back (**Figure 8-16**);

![Figure 8-16: Make sure the file guide rests on the tooth back.](image2)

» Lift the file after each stroke and do not drag the file back over the teeth;

» Over time make sure the bottom of the tooth is also filed (**Figure 8-17**);

» Replace the blade when 5mm of the blade tooth remains.

![Figure 8-17: File the bottom of the teeth to ensure the blades cutting capacity is not decreased.](image3)
The blade can be sharpened infield in the following ways:

- By making a filing stump (Figure 8-18): (a) Select a tree approximately 10cm in diameter that is due to be cut and saw off the top of the tree at hip height. (b) Turn the saw vertical and cut a groove into the stump with the left part of the blade. (c) Rest the blade snugly in the grove that has been cut and place the engine on the ground, make sure the blade does not move when filing the teeth. File each tooth and rotate the blade until all teeth have been filed on one side of the blade, turn the machine over and file the other side of the blade in the same fashion.

Figure 8-18: Making a filing stump
Against a tree (Figure 8-19): (a) Rest the blade against a tree at hip height and the engine on the ground, the operator can support the saw with their hip if need be. (b) File the teeth on one side and move to the other to sharpen the rest;

Figure 8-19: Sharpening the saw blade against a tree

Standing (Figure 8-20): Filing standing is also possible by standing the clearing saw vertical and resting the blade against the operator’s body (a) with the left hand. Make sure the blade is at a comfortable height. File one tooth at a time on one side of the blade and (b) turn the machine around to do the rest;

Figure 8-20: Filing the saw blade standing
» Sitting (Figure 8-21): (a) Sit down on a stump and let the shaft of the saw rest on the operator’s leg. Hold the blade with one hand and file with the other. Make sure that the operator positions the saw so that filing is done in the correct manner. (b) Turn the saw around and file the other side.

![Figure 8-21: Filing the saw blade while sitting](image)

8.10.2 Filing errors on a clearing saw blade

The following filing errors can occur:

» If the file guide only makes contact with the front of the tooth back, the depth of the tooth may be too big and cause aggressive cutting and increase the potential for kickback;

» If the file guide sits too high on the tooth, the file gauge contacts the rear of the tooth and the tooth will not bite into the wood enough.

8.10.3 Rock damage on a clearing saw

If the clearing saw blade hits a rock during operating, usually only a few teeth are damaged or the attachment could be dented. Stop the machine and if the damage is not too severe, use the file gauge or file to file the whole attachment until the teeth or cutting areas are even and the damaged area is no longer visible.

If the clearing saw blade hits a rock a flat file can be used to file the top of the tooth down until the damage is gone. The same amount must be filed of each tooth to ensure the blade is balanced. A repair of this nature should be done with the blade in a vice. Always set the teeth after this operation.

**IMPORTANT:**

- If the damage to the blade is too severe i.e. when dented or cracks occur in the blade, discard and replace the blade.
8.11 Setting the clearing saw blade

In order to maintain optimum cutting capacity, the blades of the saw must be ‘set’. This is done to prevent the blades from getting stuck in the kerf of the cut. As a rule of thumb, the harder the wood being cut the more often the blades need to be set.

Use the manufacturer supplied file gauge to set the blades. Each saw tooth should be set out approximately 1mm from the plane of the blade (Figure 8-22).

![Figure 8-22: Use a file gauge (a) to set the blade and (b) the file gauge also has a check to make sure the blade tooth is set 1mm out of the plane of the blade.](image)

8.12 Maintaining and replacing attachments on a clearing saw

Clearing saw blades should be replaced when cracks develop and when there is less than 5mm of tooth area left to be sharpened. To avoid damage to the unit, do not use attachments (blades) not designed for, or that have been modified, on the unit.

8.13 Drive mechanism

Refer to the operator’s manual with regard to drive mechanism maintenance.
9. Brush cutters and mulchers

Brush cutters are outdoor power equipment used for grass and herbaceous weeds for the majority of the time they are operational. The unit comprises of a mowing head (or blade) that is attached to a drive shaft and powered by a motor through gearing inside the casing of the shaft. This is not a clearing saw as the angle of the gear head/blade is configured/designed so that blade cuts horizontal to the ground. Included in this chapter is a form of brush cutter with a sturdier but similar gear head to that of a brush cutter, called a mulcher.

9.1 External components

The unit comprises of the unit and an appropriate harness to attach the unit to the operator for ergonomic operation. External components of the unit include the following (Figure 9-1):

Figure 9-1: External components of mulcher.
9.1.1 Brush cutter and mulcher design

The brush cutter is designed to be held and supported by a harness attached to the operator for ergonomic and safe use (Figure 9-2).

Figure 9-2: Working stance of a correctly set-up of a (a) brush cutter and (b) a mulcher.
9.1.2 *Brush cutter and mulcher harness*

For ergonomic safe use, ensure that the brush cutter/mulcher harness is set up properly. Follow the steps detailed in *Section 5.4*.

The brush cutter and mulcher are operated in different ways. Ensure that the harness is set up to balance these different techniques and not strain the operator.

9.1.3 *Brush cutter and mulcher set up*

Setting up a brush cutter should be done in the following way:

**Suspension ring:** Adjust and fasten the ring so that the handle bars are horizontal when the unit is hanging freely.

**Distance above the ground:** Make sure that the unit is hanging freely and the cutting attachment is horizontal, just above the ground surface.

**Adjust the handles:** Make sure that the wrist is straight and the angle of your elbow is approximately 120°. The handlebars should also be adjusted so that they are right in front of the arms, and the wrist angle is straight.
9.2 Personal protective equipment

Due to the brush cutter being used to cut vegetation, utilising a mowing head to do so, PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an accident.

9.2.1 Safety helmet

A brush cutter helmet with ear protection and visor are required at a minimum, some organisations may require an additional eye visor. The specifics of the safety helmet are found in Section 5.3.1.

9.2.2 Eye protection

It is important that the operator wears eye protection that is at a minimum a visor usually as a part of the combination safety helmet. These visors are designed to deflect or stop small particles such as wood chips, however, the visor will not completely prevent fine particles from penetrating the eye. In some cases, health and safety guidelines may recommend the use of safety glasses to prevent this. Details of minimum requirements for eye protection are found in Section 5.3.3.

9.2.3 Hearing protection

Hearing protection is usually attached to the safety helmet. Ensure that the hearing protection complies with guidelines in Chapter 5.3.2.

9.2.4 Gloves/mitts

Sturdy tight fitting gloves with a wrist strap should be worn, giving the operator a good feel and grip on the handlebars. These should preferably be made of leather. Ensure that the gloves are replaced when worn or as per manufacturers specifications.

9.2.5 Leg protection

Strong durable trousers should be worn as a minimum, with shin protectors and a vinyl/plastic apron as an optional recommended extra.

9.2.6 Footwear

Appropriate safety boots with adequate steel toe protection to provide protection against the running mowing head and other rolling obstacles should be used. It is recommended to use footwear complying with the EN ISO 20345:2004 standard. Boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support and an adequate level of cut resistance. Lace-up types must be securely fastened to prevent tripping over laces.
9.3 Other accessories and tools required

The brush cutter and mulcher operator should be equipped with the following:

- Files to sharpen the blade (file and file guide) if fitted;
- A suitable harness to fasten the saw to the operators body;
- Spanner for spark plug, screw driver combination spanner to tighten nuts and bolts on the unit and a screwdriver;
- Tools to change the blade;
- A suitable container for fuel;
- Cloth/brush for cleaning the brush cutter;
- Whistle to be carried for emergencies;
- Spare blades, blade key and locking key for bevel gear (if fitted).

The following equipment and tools should be available on site:

- First aid kit in close proximity;
- Radio or mobile phone for emergency contacts;
- Fire extinguisher.

9.4 Carrying and moving the brush cutter and mulcher

When moving the unit long distances or transporting the unit, always ensure the unit is switched off and an appropriate transport guard is fitted to the cutting attachment.

9.5 Before using the brush cutter and mulcher

Before using the unit make sure the following checks are done:

9.5.1 Pre-start safety checks

Ensure that the appropriate safety checks are done prior to operating the brush cutter and mulcher. These include:

- Check for cracks in the blade or the support flange. If cracks are found, discard the blade;
- Ensure the lock nut is firmly tightened, discard the lock nut according to manufacturer’s specifications as the nylon locking ring in the nut has a limited lifespan (usually after 10 uses);
- Check the blade guard for damage. Do not use a machine if the guard is damaged;
- Make sure the throttle control and the shut-off switch are functioning. Make special note that the throttle lockout is working;
- Make sure the deflector is fitted and not damaged;
- Ensure the fuel cap is tightened;
- Ensure no fuel spillage;
- Check that the harness is sitting properly and that the safety release works.
Once started check:

» That the cutting attachment doesn't rotate during idle and;
» The silencer works and the spark arrestor is not blocked.

**9.5.2 Starting**

The machine can be started ‘cold’ first thing in the day or after a long break or ‘warm’ when the engine has been off for a short time.

The cold start procedure is:

» Turn the switch to the ‘start’ position;
» Put the choke control in the choke position;
» Squeeze the primer fuel pump bulb (the bulb doesn't need to completely fill).

The warm start procedure is to follow the same procedure as a cold start, except do not choke the machine.

To start the machine:

» Make sure no one is in the working area (safety distance of 15m);
» Place the machine on the ground so that the blade is clear of the ground and other objects;
» Grab the starter handle with your right hand and pull the cord until you feel some resistance, then pull the cord with a vigorous motion;
» If a cold start, turn off the choke once the engine fires and pull the starter cord to start the machine;
» Give the machine full throttle (the start throttle shuts off automatically);
» To stop the engine use the engine stop switch.

---

**IMPORTANT:**

• Never wrap the starter cord around your hand;
• Do not pull the cord all the way out and do not let go of the start handle when pulled all the way out. This will damage the starter mechanism.

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**9.5.3 Refuelling**

The following procedure should be performed when refuelling a brush cutter or mulcher:

» Use a fuel container with overflow protection to avoid spills (non-spill spout) (Figure 9-3);
» Wipe the fuel cap clean to prevent contamination of the fuel in the tank;
» Shake the fuel in the fuel container to ensure a proper mix of oil and fuel;
» Open the fuel cap carefully;
» Close the fuel cap carefully;
» Start the machine at least 3m away from refuelling area for safety.
9.6 Using a brush cutter and mulcher

It is important to understand some basic principles of working with a brush cutter/mulcher.

9.6.1 Reactive forces

When using metal cutting tools (grass cutting blades, brush knives, shredded blades and circular saw blades) there is a risk of kick out when the shaded area Figure 8-6 of the rotating blade comes into contact with a solid object like a tree trunk, branch, stump, rock, etc. The machine is thrown to the right or the rear. The risk of kick out is greatest when the black area of the rotating blade comes into contact with a solid object. Do not use this area of the circular saw blade for cutting. If you are not alert and you make contact with this area of the blade, it could throw you off balance and cause serious injury. There is also a risk of kick out when using the lighter shaded area of the blade. These areas of the blade should only be used by specially trained operators.

9.6.2 Good operating technique

Operating the brush cutter/mulcher properly ensures the task at hand is completed efficiently and ergonomically.

9.6.2.1 Holding the brush cutter/mulcher

Always hold the brush cutter/mulcher firmly with BOTH hands on the handles. The control handle is in the right hand. Wrap the fingers tightly around the handles, keeping them cradled between the thumb and forefinger. Keep the machine under control at all times. Loss of control can result in serious injury or death.

Note the following:

» Make sure that the equipment handles are in good condition and are free of moisture, grease, and oil;
» Never overreach whilst cutting, as this may cause loss of balance;

Figure 9-3: Similar refuelling containers for brush cutters and mulchers (spare blades will differ).
Be particularly alert and watchful because of the wearing of hearing protection. This reduces the ability to hear warning shouts or alarms and approaching vehicles.

**9.6.2.2 Operating brush cutter/mulcher productively**

Work methodology and planning ensure that the saw will be used productively. Firstly be aware of the following environmental conditions:

- **Slope**: Caution is to be exercised on steep slippery slopes. It is preferable to work up the slope where conditions are very steep.
- **Rocky areas**: Caution is to be exercised as there is a danger of hitting unseen rocks hidden in vegetation. Never allow the cutting attachment to come into contact with stones, rocks or the ground as this will immediately dull and potentially crack the saw blade.
- **Vegetation size**: It is not recommended to fell vegetation or stems with a stem diameter larger than the radius of the cutting blade or out of the capabilities of the cutting attachment.

The operator should be aware of and practice the following:

- The correct equipment must always be selected for the task. This significantly reduces risk and improves productivity;
- Ensure sound footing and a stable posture;
- Change the direction of the operating swath when terrain becomes steeper and walk across the slope on the contour to reduce fatigue;
- Before engaging the cut, accelerate the engine to full throttle ensuring there are no obstacles in front of the saw blade;
- Ensure that the correct portion of the saw blade is used and the tilt is positioned to facilitate the required felling direction (see Section 8.7).
- Delays should be avoided by ensuring the following:
  - Sufficient fuel and lubricant is available for the shift;
  - Plan refuelling so as to avoid walking long distances to refuel;
  - Spare sharp blades must be available if blades are sharpened at the workshop;
  - Where a team of brush cutters/mulchers is working, allocate a clearly defined area to each operator to avoid walking long distances between rows.
- All brush cutters/mulchers must be in good working order;
- Ensure saw blades are sharpened and balanced regularly (to avoid vibration) and ensure efficient cutting by following the given training procedure.
Operating methods and techniques

The following operating techniques can be used for different types of vegetation:

9.6.3.1 Grass cutting

Simply swing the machine from right to left and back again advancing one step at a time. The cutting tool rotates counter-clockwise/anti-clockwise, so the cuttings always fall on the mown side and do not interfere with the next cutting line (Figure 9-4).

Figure 9-4: Grass cutting method

Large level areas are best cut using the square method. Divide the area into roughly equal squares of roughly 30-50 metres and tackle them one at a time. Work clockwise from the outside of the square towards the middle (Figure 9-5). The advantage of this method is that the cut grass never hinders progress.
The strip method can also be used for large areas. This is particularly useful when working for long periods of time, as it gives the operator a certain amount of relief when he walks back over the cut area to start on the next strip. Plan the work to start on the left of the area to be mown so that the cut grass does not interfere with the next strip to be cut. **Work in strips approximately 1.5 metres wide.**
Slopes are most easily cut using the strip method (Figure 9-6). Start at the bottom of the slope and work horizontally across the slope (not up and down!). Ensure a secure footing when working on a slope. Always keep the bodyweight on the downhill side when doing the cutting stroke, which is in the uphill direction. The grass will fall to the downhill side. At the end of the first strip, walk back along the cut area and start on the next strip above. The cut grass will always fall onto the mown area below.

![Figure 9-6: Sloped area grass cutting](image)

When working in tall grass or tough weeds, it is best to cut in both directions of the swing (Figure 9-7). Chop off the upper part of the grass on the right swing and the lower part on the left or return swing.

![Figure 9-7: Cutting tall grass areas](image)
Rounding obstacles without difficulty is best done using a nylon line, as this will be less likely to damage the trunk or branches (**Figure 9-8**). Mow, moving to the right, in a circle.

![Figure 9-8: Cutting around obstacles](image)

### 9.6.3.2 Wild growth and scrub

A mulcher can be used to cut wild growth and scrub:

» The mulcher can be used in an up and down motion, progressively raising and lowering the blade on to the material needed to be cleared (**Figure 9-9**);

» Be very careful when using this method as the mulcher attachment can throw cuttings towards the operator when off the ground;

» Planning your work will make it flow more easily and quickly;

» Make sure to examine difficult terrain before starting to cut, to identify any possible hazards;

» Keep the eyes on the cutting tool at all times whilst working.
9.6.3.3 Bushes and small trees

The brush cutter is used to clear heavy bush/shrubs and small trees in general landscaping, forestry operations and road maintenance. It is used in forestry plantation maintenance, to remove excess growth under the trees so as to reduce competition and improve the conditions in which the trees can grow. Clean rows between the trees also make the harvesting operation much easier. It is also used in thinning operations in young stands.

Two methods have proved advantageous for mowing in plantations, namely strip cutting and release cutting.

Strip cutting: The strip cutting working technique depends on the distance between the rows of plants (Figure 9-10). The operator should use a ‘meandering’ pattern moving up and down the paths, cutting them alternately.

![Figure 9-9: Operating technique for a mulcher](image)

**Figure 9-9: Operating technique for a mulcher**

![Figure 9-10: Strip cutting technique](image)

**Figure 9-10: Strip cutting technique**
If there is less space between the rows of plants, the operator must walk close to the left-hand row of plants (Figure 9-11). Start mowing approximately 0.5 meters to the right of the plant and complete your sweep 1 meter to the left. This method is also recommended if it is necessary to work at right angles to the slope instead of following the rows of plants. Large areas are mown in squares. As soon as the square is complete, the tools and fuel canister are moved to the next square.

A similar method is also used if the young plants are overgrown. Start mowing on the immediate left of the first visible plant and carefully move forwards, following a theoretical straight line.

![Figure 9-11: Strip cutting if trees are overgrown](image)

**Release cutting:** Release cutting is particularly suitable for maintaining young stands (Figure 9-12). The advantage of this is that it requires much less work because wild growth is only cleared from around the plant – everything else is left standing. This saves energy and money.

Start mowing to the left of the plant (1) and move the cutting tool forward in a circular movement (2), then back and round the right-hand side of the plant (3). Once the plant has been cleared, the machine is advanced diagonally to the left of the next plant (1). Larger plants are briefly pushed away with the protective tube.

![Figure 9-12: Release cutting around plants](image)
9.7 Cutting attachments

Making sure the attachment is well serviced and not damaged to ensure the brush cutter/mulcher will operate to its optimum and not put strain on the equipment or the operator.

In general, the two attachments in Figure 9-13 are used for mulchers and brush cutters respectively.

![Figure 9-13: Attachment for (a) mulcher and (b) a brush cutter.](image)

9.7.1 Other types of cutting attachments

The following cutting attachments can be used:

<table>
<thead>
<tr>
<th>Application</th>
<th>Cutting attachment</th>
<th>Defector</th>
<th>Handle</th>
<th>Harness</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass and grass around obstacles</td>
<td>Deflector</td>
<td>Handle</td>
<td>Harness</td>
<td></td>
<td>Grass only requires cutting attachments with plastic or nylon line are used</td>
</tr>
<tr>
<td>Type of Vegetation</td>
<td>Cutting Attachments</td>
<td>Description</td>
<td></td>
<td></td>
<td></td>
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<td>---------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
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<td></td>
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<tr>
<td>Light herbaceous weeds</td>
<td>Due to the grade of weed being cut, attachments with stronger plastic or nylon line or light weight metal blade type attachments can be used</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Woody herbaceous weeds</td>
<td>This type of vegetation requires more robust cutting attachments that are able to deal with heavier grade weeds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reeds and woody bushes</td>
<td>This type of vegetation requires more robust cutting attachments that are able to deal with heavier grade weeds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy bushes and thin trunks</td>
<td>Due to the design of the brush cutter/mulcher, it is not designed to deal with heavy bushes and thin trunks constantly. However, it is possible to use light weight cutting attachments for this purpose.</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

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9.7.2 Maintaining the attachment

Safe operating of the brush cutter/mulcher relies on sound attachment maintenance.

**IMPORTANT:**
- Always switch off the engine and stop the saw before handling or inspecting the blade.

9.7.2.1 Fitting and changing the cutting attachment

Changing the attachment can be done by doing the following (Figure 9-14):

- Place the brush cutter/mulcher upside-down on a firm surface;
- Lock the cutting tool with the locking pin from the tool kit;
- Loosen the mounting nut with the combination wrench/spanner and place or remove the cutting tool and follow the fitment procedure:
  - Fit the drive disc (B) on the output axle;
  - Turn the blade axle until one of the holes in the drive disc aligns with the hole in the gear housing;
  - Insert the locking pin (C) in the hole so that the axle is locked;
  - Place the blade (D), support cup (F) and the support flange (E) on the output shaft;
  - Fit the nut (G), using the socket spanner. The nut is tightened when the spanner is turned anti-clockwise (left-hand thread).

**Figure 9-14: Fitting the attachment**

9.7.2.2 Fitting a deflector

It is of great safety concern to have a deflector attached to the brush cutter. Ensure that the correct guard is fitted if you have changed the type of cutting attachment to be used. Each must be fitted according to manufacturer’s specifications.

Ensure the following procedure is followed when fitting the deflector guard:

- Secure the guard to the fitting plate;
- Ensure the guard is secure;
- Attach the desired cutting head and make sure the blade is secure.

9.7.2.3 Maintaining the trimmer head

Check manufacturer’s specifications with regard to the cord to be used and the fitting procedure. Replace when necessary – do not waste cord.

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When using a trimmer head:

» Open the trimmer head and check that there is enough line on the spool;
» Make sure that the line is correctly wound, without any crossovers;
» Wind more line onto the head if necessary. Make sure that you hold the nylon line tightly when you are winding it onto the spool;
» With the auto-cut head you just need to insert the pre-cut line and turn the head to secure it;
» Check the mowing head for wear and cracks.

If using a Polycut (plastic or nylon cord) and any of the blades are damaged, all three blades should be replaced at the same time. The Polycut is used for edging fields not bordered by posts, fences, trees or other obstacles.

9.7.2.4 Maintaining and sharpening cutting heads

Incorrect cutting equipment or an incorrectly sharpened blade increases the risk of kick out and reduces the efficiency of the machine (similar to Section 8.10).

GENERAL RULES for sharpening blades (Figure 9-15):

» Always wear safety gloves when sharpening saw blades;
» Never straighten or weld a bent or cracked cutting blade. It might shatter during use and cause serious or fatal injury;
» Re-sharpen often, taking away as little material as possible. Two or three strokes of the file are usually enough;
» To avoid ‘out of balance’ re-sharpen the cutters (1) uniformly. Do not alter the contour of the parent blade (2) in any way;
» Should you feel any undue vibration whilst operating the machine, this could be caused by wrong sharpening procedures which have unbalanced the blade, or the blade may have been bent or chipped through contact with a foreign object. It is vital that this is reported to the supervisor immediately for corrective action;
» Sharpen the grass cutting blade according to manufacturer’s specifications.

![Figure 9-15: Sharpening the blades](image-url)
9.8 Maintaining the brush cutter/mulcher

It is important for safety and efficiency reasons, that the machine is kept in good working order at all times. However, do not attempt any maintenance or repair work not described in the owner's manual. All other work should be carried out by an approved service dealer.

The operator must ensure to clean grass cuttings and plant residue off the cutting tool mounting at regular intervals. If the cutting tool or deflector becomes clogged or stuck, always turn off the engine and make sure that the cutting tool has stopped before attempting to clean it.

Correct maintenance and use of the right cutting attachment can reduce the machine's tendency to kick out, obtain maximum clearing capacity and increase the service life of the cutting equipment.

Standard daily, weekly and monthly maintenance schedules should be applied. The operator is only responsible for the daily checks. The weekly and monthly services are only to be carried out by designated technicians who have been specifically trained to do so.

9.8.1 Daily maintenance

The more often the machine is serviced, the better it will keep and the easier it will be to work with. Conduct the following checks on a daily basis:

» Check that the metal cutting tool is undamaged and does not have cracks in it. An unbroken cutter will resonate for some time when tapped with a metal object. Tap the circular saw blade at several points all around to make sure that it is not fractured;
» Make sure that the cutting blade is sharp and evenly sharpened so that it is well balanced;
» Check that all nuts and bolts are secure. The self-locking nut on the cutting tool must be replaced if it can be turned by hand. Remember that this nut has a left-hand thread, so that it does not loosen as the blade turns;
» Clean the outside of the machine and the deflector/guard;
» Clean the air intake openings if necessary;
» Clean the air filter according to the manufacturer's specifications;
» Any problems found in the above check list should be referred to the supervisor for immediate attention.

9.8.2 Maintaining the air filter

Dirt in the air filter will cause a noticeable loss in engine power. The air filter should be cleaned regularly to avoid:

» Carburettor malfunction;
» Starting problems;
» Reduction in engine power;
» Unnecessary wear to engine parts;
» Abnormal fuel consumption.

Because air filters are not exactly the same, the air filter must be cleaned as per manufacturer's specifications. A damaged air filter must be replaced.

9.9 Drive mechanism

Refer to the operator's manual with regard to drive mechanism maintenance.
10. Earth auger

Earth augers are outdoor power equipment used for augering holes into soil for the purpose of planting poles or making pits for planting trees and seedlings. The unit comprises of a cutting head that is attached to a drive shaft and powered by a motor through gearing inside the casing of the shaft.

10.1 External components

An earth auger comprises of the following components (Figure 10-1):

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oil filler</td>
</tr>
<tr>
<td>2</td>
<td>Air filter cover</td>
</tr>
<tr>
<td>3</td>
<td>Choke control</td>
</tr>
<tr>
<td>4</td>
<td>Throttle control</td>
</tr>
<tr>
<td>5</td>
<td>Gear case</td>
</tr>
<tr>
<td>6</td>
<td>Auger or drill</td>
</tr>
<tr>
<td>7</td>
<td>Cutter part of auger</td>
</tr>
<tr>
<td>8</td>
<td>Cutting equipment</td>
</tr>
<tr>
<td>9</td>
<td>Start throttle button</td>
</tr>
<tr>
<td>10</td>
<td>Stop switch</td>
</tr>
<tr>
<td>11</td>
<td>Starter handle</td>
</tr>
<tr>
<td>12</td>
<td>Air purge</td>
</tr>
<tr>
<td>13</td>
<td>Fuel tank</td>
</tr>
<tr>
<td>14</td>
<td>Spark plug and cap</td>
</tr>
<tr>
<td>15</td>
<td>Cylinder cover</td>
</tr>
<tr>
<td>16</td>
<td>Operator's manual</td>
</tr>
<tr>
<td>17</td>
<td>Screw driver</td>
</tr>
<tr>
<td>18</td>
<td>Combi-spanner</td>
</tr>
<tr>
<td>19</td>
<td>Socket spanner</td>
</tr>
<tr>
<td>20</td>
<td>Hip brake (some manufacturers fit these components as a standard)</td>
</tr>
</tbody>
</table>

Figure 10-1: Main part of an earth auger
10.1.1 Earth auger design

The earth auger is a hand held machine that is carried to a point and powered up and guided to auger holes in soil (Figure 10-2).

**Figure 10-2: Working stance of an earth auger for operation**

10.1.2 Earth auger set-up

**Holding the earth auger:** Make sure that the earth auger is held upright with a comfortable stance. When engaging the throttle, guide the auger bit into the ground by applying downward force.

**Hip brake (if fitted):** When engaging the earth auger, make sure the brake is disengaged. If needed the brake can be engaged by the operator’s leg.

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10.2 Personal protective equipment

Due to the earth auger being used to make holes in soil utilising a rotating cutter to do so, PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an accident.

10.2.1 Safety helmet

The use of a safety helmet depends on the situation where the operation is taking place. Usually safety helmets are only recommended when working under a tree canopy. The helmet is fitted with ear protection and could include a visor, or not. Due to the noise emitted from the earth auger unit, hearing protection is necessary. The requirements for safety helmet are found in Section 5.3.1.

In most applications of this machine, a sun hat is recommended as many operations will be done working in the open with no risk of falling objects.

10.2.2 Eye protection

Eye protection is recommended when using an auger. The eye protection can either be in the form of a visor attached to a safety helmet or a pair of safety glasses. Details of minimum requirements for eye protection are found in Section 5.3.3.

10.2.3 Hearing protection

Hearing protection is a requirement when operating a mechanical auger. Hearing protection is usually attached to the safety helmet. Separate earmuffs can also be used when a safety helmet is not used. Ensure that the hearing protection complies with guidelines given in Chapter 5.3.2.

10.2.4 Gloves/mitts

Sturdy tight fitting gloves with a wrist strap should be worn, giving the operator a good feel and grip on the handlebars. The gloves should preferably be made of leather. Ensure that the gloves are replaced when worn or as per manufacturer’s specifications.

10.2.5 Leg protection

Strong durable trousers should be worn as a minimum, with shin protectors as an optional recommended extra.

10.2.6 Footwear

Appropriate safety boots with adequate steel toe protection to provide protection against rolling objects should be used. The boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support and an adequate level of cut resistance. Lace-up types must be securely fastened to prevent tripping over laces.
10.3 Other equipment and tools required

The earth auger operator should have the following tools and items available:

» Spanner, screw driver or spark plug and screw driver combination spanner to tighten nuts and bolts on the unit;
» Tools to change the auger bit;
» A suitable container for fuel;
» Cloth/brush for cleaning the auger;
» Whistle to be carried for emergencies;
» Spare locking nuts and pins to attach the auger bit to the unit.

The following equipment and tools should be available on site:

» First aid kit in close proximity;
» Radio or mobile phone for emergency contacts;
» Fire extinguisher.

10.4 Carrying and moving machine

The auger should be switched off when moving the machine over long distances. The unit should be transported, enclosed and separate from the operators.

10.5 Before using an auger

Follow the following steps before using the auger:

10.5.1 Pre-start safety checks

» Check for cracks in the auger cutter. If cracks are found report the findings and if severe, discard the attachment (see Chapter 10.7);
» Ensure the nuts and bolts are firmly tightened;
» Make sure the throttle control and the shut-off switch are functioning, and make special note that the throttle lockout is working;
» Ensure the fuel cap is tightened;
» Make sure that the leg brake is working.

Check the cutters.

Never use cutters that are blunt, cracked or damaged.

» Check that the machine is in perfect working order.
» Check that all nuts and screws are tight.
» Check that the cutting attachment always stops when the engine is idling.
» Only use the machine for the purpose it was intended for.
» Make sure that the handle and safety features are in good working order. Never use a machine that lacks a part or has been modified outside its specifications.
» All covers must be correctly fitted and undamaged before you start the machine.
Once started:

» Check the attachment doesn’t rotate during idle and;

» Check that the silencer works and the spark arrestor is not blocked.

10.5.2 Starting

The earth auger is a high torque, fuel driven powered tool, special precautions must be observed to reduce the risk of personal injury.

Starting a cold engine:

» Ignition: Set the stop switch to the start position.

» Primer bulb: Press the air purge repeatedly until fuel begins to fill the bulb. The bulb needs not be completely filled (Figure 10-3).

Figure 10-3: The primer bulb

» Choke: Set the choke control in the choke position (Figure 10-4).

Figure 10-4: The position of the choke

» Start throttle: Set the throttle (Figure 10-5) to the start position by first pressing the throttle trigger, then pressing the start throttle button. Then release the throttle trigger, followed by the start throttle button. The throttle function is now activated. To return the engine to idle, press the throttle trigger again.
Starting a warm engine:

Use the same starting procedure as for a cold engine but without setting the choke control in the choke position.

Starting:

Hold the machine upright with the left hand (Figure 10-6). Grip the starter handle, slowly pull out the cord with the right hand until some resistance is felt (the starter pawls grip), now quickly and powerfully pull the cord.

Push the choke control back to its original position as soon as the engine fires.

WARNING!

Do not pull the starter cord all the way out and do not let go of the starter handle when the cord is fully extended. This can damage the machine.
Stop switch:

Use the stop switch to switch off the engine (Figure 10-7).

Start the engine and make sure the engine stops when the stop switch is moved to the stop setting.

Muffler:

The muffler is designed to keep noise levels to a minimum and to direct exhaust fumes away from the user (Figure 10-8).

In countries, such as South Africa, that have a warm and dry climate, there is a significant risk of fire. Certain mufflers are therefore fitted with a spark arrester mesh. Check whether the muffler on the machine is fitted with this kind of mesh (Figure 10-9). For mufflers, it is very important to follow the instructions on checking, maintaining and servicing the machine.
Never use a machine that has a faulty muffler.

Regularly check that the muffler is securely attached to the machine. If the muffler on the machine is fitted with a spark arrestor mesh, this must be cleaned regularly. A blocked mesh will cause the engine to overheat and may lead to serious damage.

**IMPORTANT:**
- Never wrap the starter cord around your hand;
- Do not pull the cord all the way out and do not let go of the start handle when pulled all the way out. This will damage the starter mechanism.

### 10.5.3 Refuelling

Refuelling involves handling flammable substances and the following must therefore be adhered to:

- Use a fuel container with overflow protection to avoid spills (Figure 16-1);
- Shake the fuel in the fuel container to ensure a proper mix of oil and fuel;
- Wipe the fuel cap clean to prevent contamination of the fuel in the tank;
- Always shut off the engine and allow it to cool before refuelling;
- Do not smoke or place hot objects near the fuel;
- Open the fuel cap slowly so that any pressure can be released slowly;
- Ensure the fuel cap is properly tightened before starting;
- Any fuel spilled must be wiped off the unit prior to starting it.
- The machine is to be started a minimum of 3m from where it is refuelled;

### 10.6 Operating an auger

Be aware of the following when operating the auger:

#### 10.6.1 Reactive forces

The earth auger can suddenly ‘pull’ in a direction when it makes contact with roots or rocks while in operation. Always be aware of this and take precautions when holding the machine.

#### 10.6.2 Holding and operating an auger

The relevant work instructions are to be followed when operating the Motor-Manual Earth Augers. The work instructions focus on how to carry out the operation safely while also taking quality and the environment into consideration.

Holding the auger should be done in the following way:

- Apply 50% of body weight to the machine when augering, full body weight can cause balance issues;
- Splurge the machine when operating and always avoid being pulled by the machine during the pitting (machine might pull you forward if it gets caught in a root);
» The machine must be above the operator when operating on steep slopes;
» There must be a triangular space between the operator’s feet and the auger head – the triangle must be observable;
» The operator should limit back bending and ensure firm footing and to avoid being pulled by the machine (Figure 10-10);
» When encountering a rocky surface, move to another area;
» When moving from one pit to another the auger must be lifted off the ground facing sideways;
» Do not lean over the top of the machine when making a hole/pit;
» Always make sure the auger is making pits that are straight through the soil surface;
» A safe working distance of 5m should be maintained at all times;
» All people are to be aware of safety risks associated with the terrain:
  • Steep slopes and underfoot conditions (rocks, brushwood, holes in the ground etc);
  • Carrying the Motor-Manual Earth Auger between pits potentially increases the risk of slips, trips and falls.

Figure 10-10: The correct stance of the auger operator, avoiding excessive bending of the back and a firm foot position to limit being pulled by the machine
General safety:

» Be aware of the dangers of heat stress and ensure there is sufficient drinking water available on site.
» Operators are exposed to noise while operating with these machines. Ensure appropriate hearing protection is worn at all times during operating.
» Medical surveillance is to include a baseline audiogram, followed by an annual audiogram and an exit audiogram. This is to monitor and ensure no operator develops noise induced hearing loss.
» Operators are to be informed of the risk of exposure to vibration. They are to report any symptoms of overexposure to vibration which may include numbness, loss of feeling, tingling, pricking, pain, loss of strength, changes in skin colour or condition in the fingers, hands or limbs. The risk of overexposure to vibration increases when the machine is used in cold weather.

10.6.3 Productive operation of an earth auger

**WARNING:**

When using an earth auger for productive purposes it is recommended to operate the machine in two-man teams.

Always ensure that the following items are available or planned for:

» Sufficient fuel and lubricant is available for the shift;
» Where a team of Motor-Manual Augers are working allocate a "block" within the compartment to each two-man auger team to avoid long walking distances between rows;
» The fuel containers are carried by the second operator to the unit in order to avoid unnecessary walking to refuel. At refuelling the operators are to swap tasks;
» Sufficient spares must be available on site to avoid unnecessary breakdown delays;
» A team member should be trained in basic trouble shooting and repairs.

10.6.4 Augering quality

» Minimum pit dimension using a motor manual system should be as per specific operational requirement for example 200 mm deep x 200 mm diameter.
» Pits must have a good soil tilth, no clods, be debris free and they must be covered with soil for planting to prevent drying out (Figure 10-10).
10.7 Attachment maintenance and attachment types

Productive operations rely on sound maintenance and the choice of the correct attachment for the conditions.

10.7.1 Attachment maintenance

Always check the auger cutting head before operating:

» Check that the machine is in perfect working order;
» Check that all nuts and screws are tight;
» Check that the attachment always stops when the engine is idling;
» Only use the machine for the purpose it was intended for;
» Make sure that the handle and safety features are in good working order.
» Never use a machine that lacks a part or has been modified outside its specifications;
» Keep the auger tip and blade free of soil and root build-up at all times – this will affect the penetration of the auger into the soil;
» Check the cutters. Never use cutters that are blunt, cracked or damaged. Ensure that the cutters are securely attached. **Worn blades cannot be sharpened conventionally and should be discarded.**
10.7.2 Types of attachments

Auger attachments come in various forms for different functions, some examples of these are:

**Archimedes screw type**

**Soil loosening type**

**IMPORTANT:**

It is advisable to only use manufacturer specific auger attachments. Modified or manufactured attachments run the risk of being ‘un-balanced’ and can affect the drive mechanism of the machine.
11. Pole pruner and clearing pole saw

This derivative of a pole mounted chain saw comes in the form of pole pruners and a clearing pole saw. This outdoor power equipment is designed for cutting branches off woody vegetation. The unit comprises of a chain saw that is attached to a drive shaft and powered by a motor, through gearing inside the casing of the shaft. The clearing pole saw is similar to the pole saw but supported by a backpack-harness on the operator. This is not a chain saw.

11.1 External components of the pole pruner and clearing pole saw

The pole pruner unit comprises of the following parts (Figure 11-1):

![Figure 11-1: Parts of a pole pruner](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chain lubrication adjustment screw</td>
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<tr>
<td>2</td>
<td>Shaft</td>
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<tr>
<td>3</td>
<td>Front handle</td>
</tr>
<tr>
<td>4</td>
<td>Throttle trigger</td>
</tr>
<tr>
<td>5</td>
<td>Stop switch</td>
</tr>
<tr>
<td>6</td>
<td>Throttle trigger lockout</td>
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<tr>
<td>7</td>
<td>Harness support</td>
</tr>
<tr>
<td>8</td>
<td>Cylinder cover</td>
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<tr>
<td>9</td>
<td>Starter handle</td>
</tr>
<tr>
<td>10</td>
<td>Fuel tank</td>
</tr>
<tr>
<td>11</td>
<td>Choke control</td>
</tr>
<tr>
<td>12</td>
<td>Air purge</td>
</tr>
<tr>
<td>13</td>
<td>Air filter cover</td>
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<tr>
<td>14</td>
<td>Protective guard for saw chain</td>
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<tr>
<td>15</td>
<td>Bar nut</td>
</tr>
<tr>
<td>16</td>
<td>Saw chain</td>
</tr>
<tr>
<td>17</td>
<td>Guide bar</td>
</tr>
<tr>
<td>18</td>
<td>Chain tensioning screw</td>
</tr>
<tr>
<td>19</td>
<td>Chain oil tank</td>
</tr>
<tr>
<td>20</td>
<td>Filing oil tank</td>
</tr>
<tr>
<td>21</td>
<td>Operator’s manual</td>
</tr>
<tr>
<td>22</td>
<td>Transport guard, bar</td>
</tr>
<tr>
<td>23</td>
<td>Allen key</td>
</tr>
<tr>
<td>24</td>
<td>Combination spanner</td>
</tr>
<tr>
<td>25</td>
<td>Combination spanner chain tensioner</td>
</tr>
<tr>
<td>26</td>
<td>Harness</td>
</tr>
<tr>
<td>27</td>
<td>Harness</td>
</tr>
<tr>
<td>28</td>
<td>Shaft coupling</td>
</tr>
<tr>
<td>29</td>
<td>Impact guard</td>
</tr>
<tr>
<td>30</td>
<td>Spark plug cap and spark plug</td>
</tr>
</tbody>
</table>
The clearing pole saw unit comprises of the following parts (Figure 11-2):

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oil filter cover</td>
</tr>
<tr>
<td>2</td>
<td>Starter handle</td>
</tr>
<tr>
<td>3</td>
<td>Load reducer</td>
</tr>
<tr>
<td>4</td>
<td>Fuel tank</td>
</tr>
<tr>
<td>5</td>
<td>Stem guard</td>
</tr>
<tr>
<td>6</td>
<td>Cylinder cover</td>
</tr>
<tr>
<td>7</td>
<td>Spark plug and spark plug cap</td>
</tr>
<tr>
<td>8</td>
<td>Choke control</td>
</tr>
<tr>
<td>9</td>
<td>Harness</td>
</tr>
<tr>
<td>10</td>
<td>Air purge</td>
</tr>
<tr>
<td>11</td>
<td>Cord</td>
</tr>
<tr>
<td>12</td>
<td>Throttle control</td>
</tr>
<tr>
<td>13</td>
<td>Throttle/hand guard</td>
</tr>
<tr>
<td>14</td>
<td>Throttle lockout</td>
</tr>
<tr>
<td>15</td>
<td>Stop switch</td>
</tr>
<tr>
<td>16</td>
<td>Shaft coupling</td>
</tr>
<tr>
<td>17</td>
<td>Loop handle</td>
</tr>
<tr>
<td>18</td>
<td>Suspension ring</td>
</tr>
<tr>
<td>19</td>
<td>Shaft</td>
</tr>
<tr>
<td>20</td>
<td>Chain lubrication adjustment screw</td>
</tr>
<tr>
<td>21</td>
<td>Bar nut</td>
</tr>
<tr>
<td>22</td>
<td>Bar</td>
</tr>
<tr>
<td>23</td>
<td>Transport guard bar</td>
</tr>
<tr>
<td>24</td>
<td>Chain tensioning screw</td>
</tr>
<tr>
<td>25</td>
<td>Chain oil tank</td>
</tr>
<tr>
<td>26</td>
<td>Chain</td>
</tr>
<tr>
<td>27</td>
<td>Protective guard for saw chain</td>
</tr>
<tr>
<td>28</td>
<td>Filling with chain oil</td>
</tr>
<tr>
<td>29</td>
<td>Operator manual</td>
</tr>
<tr>
<td>30</td>
<td>Combination spanner</td>
</tr>
<tr>
<td>31</td>
<td>Spark plug spanner</td>
</tr>
</tbody>
</table>

Figure 11-2: Parts of a clearing pole saw
11.1.1 Pole pruner and clearing pole saw design

The pole pruner and clearing pole saw are hand held or operator assisted harness mounted tools (Figure 11-3).

![Figure 11-3: Working stance of a (a) pole pruner and (b) clearing pole saw](image)

11.1.2 Pole pruner and clearing pole saw set-up

Both units require the use of harnesses for safe and ergonomic work. The procedure to set up the units is as follows:

- **Harness set up:** Adjust the harness and tighten/set up the straps as in Section 5.4 for each of the machines.

- **Harness support (pole pruner):** Adjust and fasten the ring so that unit is balanced when the operator holds it for work.

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**Bungee cord and suspension ring (clearing pole saw):** Attach the bungee cord to the pole saw suspension ring from the harness, pull and adjust the height of the saw by pulling the bungee cord. Make sure the pole saw is at a comfortable height.

**Working stance:** Make sure that the units are set up comfortably for safe and effective work.
11.2 Personal protective equipment

Due to the pole pruner generally being used under vegetation to cut branches off trees, PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an incident.

11.2.1 Safety helmet

Due to the application of pole pruners, working under a tree canopy or working with the risk of branches or other vegetative material falling on the operator, a combination helmet with ear protection and visor are required as a minimum standard. In some cases, health and safety standards (particular to organisations) may require an additional eye visor. The specifics of the safety helmet are found in Section 5.3.1.

11.2.2 Eye protection

It is important that the operator wears eye protection that is at a minimum a visor. This visor is usually a part of the combination safety helmet. These visors are designed to deflect or stop small particles such as wood chips, however, the visor will not completely prevent fine particles from penetrating the eye. In some cases, health and safety guidelines may recommend the use of safety glasses to prevent this. Details of minimum requirements for eye protection are found in Section 5.3.3.

11.2.3 Hearing protection

Hearing protection is usually attached to the safety helmet. Additional hearing protection may be used in the form of earplugs. Ensure that the hearing protection complies with guidelines in Chapter 5.3.2.

11.2.4 Gloves/mitts

Sturdy tight fitting gloves with a wrist strap should be worn, giving the operator a good feel and grip on the handlebars. These should preferably be made of leather. Ensure that the gloves are replaced when worn or as per manufacturers specifications.

11.2.5 Leg protection

Strong durable trousers should be worn as a minimum.

11.2.6 Footwear

Appropriate safety boots with adequate steel toe protection to provide protection against the running saw chain and rolling logs and rocks should be used. It is recommended to use footwear complying with EN ISO 20345:2004 standard. These boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support and an adequate level of cut resistance. Lace-up types must be securely fastened to prevent tripping over laces.
11.3 Other accessories and tools required

The clearing saw operator should be equipped with the following:

- Files to sharpen the saw (file and file guide);
- A suitable harness to fasten the saw to the operator’s body;
- Spanner or combination wrench to tighten nuts and bolts on the unit and a screwdriver;
- Tools to change the saw chain;
- A suitable container for fuel and cutter bar lube (combi can);
- Cloth/brush for cleaning the clearing saw;
- Spare chain;
- Whistle to be carried for emergencies.

The following equipment and tools should be available on site:

- First aid kit in close proximity;
- Radio or mobile phone for emergency contacts;
- Fire extinguisher.

11.3.1 Safety checks before using the pole pruner

The operator needs to be adequately trained and assessed to be competent as a pole pruner operator before any operation commences.

Conduct the following safety checks:

- Check guide bar, sprocket and chain for excess wear;
- Check for chain sharpness and correct tension;
- Ensure the lock nut on the guide bar is firmly tightened;
- Check there is adequate fuel and chain lube in an appropriate container;
- Make sure the throttle control and the shut-off switch are functioning;
- Ensure the fuel cap is tightened;
- Check the harness is sitting properly and that the safety release works.

Once the machine has started, check:

- The chain doesn’t rotate while idling and;
- The muffler is in good working order and the spark arrestor is not blocked.

11.3.2 Carrying and moving the pole pruner

When moving the pole pruner over long distances or when in transit always ensure the pole pruner is switched off and an appropriate guard is fitted over the guide bar and chain. Between small moves, whilst working, the pole pruner is to be carried in its harness in a horizontal position.
11.3.3 Starting and refuelling the machine

The following procedures should be followed when starting and refuelling a pole pruner:

11.3.3.1 Starting the machine

To start the machine, the following steps need to be followed:

» Make sure no one is in the working area (safety distance of 15m);
» Clear a place where the machine will be placed, removing all debris;
» Place the machine on the ground so that the blade is clear of the ground and other objects;
» Ensure the cutting attachment is slightly elevated on a secure rest (e.g. by placing the shaft in a fork of a small tree or stable branch) to facilitate visibility as well as ensuring that it remains free of debris (Figure 11-4);
» Hold with the left hand pushing down on the shaft;
» Note - If it is a cold start then engage the choke control in the choke position and squeeze the primer fuel pump bulb. Turn off the choke once the engine fires;
» Switch machine on;
» Find compression by gently pulling the starter cord;
» Use the right hand to pull the starter cord;
» Start the machine by pulling the starter cord sharply and firmly;
» Give the machine full throttle (the start throttle shuts off automatically) and proceed to work;
» To stop the engine, use the engine stop switch;
» Note – If it is a warm start then do not utilise the choke.

Figure 11-4: Cutting attachment slightly elevated on a secure rest to facilitate visibility as well as ensuring that it remains free of debris

IMPORTANT:
• Never wrap the starter cord around your hand;
• Do not pull the cord all the way out and do not let go of the start handle when pulled all the way out. This will damage the starter mechanism.
11.3.4 Refuelling

The following procedure should be followed when refuelling a pole pruner:

» Adhere to the manufacturer’s recommendation on the mixture ratio of petrol to 2-stroke oil;
» Always fill the cutter bar lube prior to refuelling the machine;
» Use a fuel container with overflow protection to avoid spills;
» Wipe the fuel cap to prevent contamination of the fuel in the tank;
» Shake the fuel in the fuel container to ensure a good mix of oil and fuel;
» Open the fuel caps of container and machine carefully;
» Carefully fill the machine fuel tank;
» Close the fuel caps of container and machine carefully;
» Wipe away any excess fuel on the machine;
» Start the machine at least 3m away from the refuelling area.

11.4 Reactive forces

It is important to understand some basic principles of working with a pole pruner, namely the reactive forces and directional felling.

As with a chain saw the pole pruner and pole clearing saw can experience similar reactive forces such as kickback. These reactive forces are dependent on the cutting technique used and size of the material (tree/branch) being cut. When cutting small trunks and branches (0-10cm) generally a single downward action of the pole pruner (guide bar) through the stem or branch can be used without experiencing kickback.

11.5 Operating the pole pruner and pole clearing saw

The following handling points are important to adhere to when working with a pole pruner:

» Never overreach, always maintain a firm, balanced and stable foothold (Figure 11-5);

Figure 11-5: The correct angle of operation demonstrated
To reduce the risk of injury, never cut vertically above your body;

Hold the pole pruner at an angle of not more than 60° from the horizontal level and constantly be on the lookout for falling debris/branches (Figure 11-6);

![Figure 11-6: Pole pruner being held in excess of 60° and in an unsafe working position](image)

Figure 11-6: Pole pruner being held in excess of 60° and in an unsafe working position

- Do not hold the unit above shoulder height;
- Never work from a ladder, in a tree or any other unstable platform;
- Always ensure a safe, accessible and clear escape route;
- Do not use the pole pruner for any other purpose than what it was designed for nor effect any modifications;
- Always hold the unit firmly with both hands with the left hand on the shaft and right hand on the rear grip and throttle trigger, wrapping your fingers and thumbs around the handles;
- Always maintain a good balance and a firm foothold;
- The unit is not insulated against electric shock therefore ensure that it never operates in the vicinity of any electric wires or power cables;
- Prior to cutting/pruning clear the working area so it doesn’t interfere with the “work zone” as well as establishing an appropriate escape route away from where the cut branches may fall;
- Always maintain a safe working distance of at least 15m between operators/bystanders. This safety distance also applies to any power cables/electric wires.

**WARNING:**
- Be aware of the kickback zone on the saw;
- Always maintain a 15m safety distance.

**IMPORTANT:**
Always switch off the engine and stop the saw before handling or inspecting the chain.
11.5.2 Operating methods and techniques

To operate a pole pruner effectively, consider the following operating methods and techniques:

11.5.2.1 Removing branches during pruning operations

Branch sections should be removed by adhering to the following points:

» Plan the order/sequence of cuts;
» Characteristics and properties of the wood must be allowed for;
» Suitable sized sections to be removed at any one time;
» Side or reducing cuts to be used where appropriate;
» Positioning and complete overlap of cuts must be achieved to prevent the tearing of bark;
» Cut pieces to be felled into a safe area;
» The branch collar and/or branch bark ridge to be identified when pruning;
» The pruning cut to be left as smooth and flush to the stem as possible, without causing damage to the stem (Figure 11-7).

Figure 11-7: Stem damage caused during the removal of branches (a). Correct branch removal flush to the stem without causing damage (b)

11.5.2.2 Relieving Cuts

This is done to avoid kickback, pinching the bar or tearing the bark when pruning thick branches. Always start by performing a relieving cut on the underside of the branch using the following technique:

» Apply the cutting attachment and pull it across the bottom of the branch, cutting into the branch approximately a third of the diameter;
» Locate the hook against the branch, above the first under cut, and then perform the second cut to complete the cross cut.
11.5.2.3 Flush-cutting of thick branches

» If the branch diameter is greater than 10cm, first perform the under cut and then the cross cut at distance of approximately 20cm from the final cut;

» Then carry out the final flush cut close to the stem. In this way, tension is relieved and pinching of the bar is reduced.

11.5.2.4 Coppice reduction

Coppice reduction is for either the removal or selection of coppice stems as a form of establishment in hardwood stands.

» It is preferable to perform this operation during the dormant period (winter) as the bark is less likely to tear and increase stump mortality;

» All remaining stems (per stump) must be clearly identified well in advance to the operation taking place;

» When reducing coppice on slopes, start on the lower slopes and work uphill allowing the cut stems to fall away from the work-face so that the working zone is left clear;

» Ensure the remaining stems are not damaged as this can serve as an entry point for disease as well as increased potential for wind throw;

» Apply the “de-throttle” technique when approaching the selected stems or when cutting very thin stems near selected stems. ‘De-throttling’ implies the release of the throttle between cuts;

» When reducing coppice the quality of the cut is important. Cuts should be clean with no separation of the bark from the stem during the cutting process;

» Stems must be cut as low as possible to reduce the effect of feathering;

» Stems are to be felled in the direction of the inter row and not across rows into the remaining stems.

11.5.3 Cutting problems

Use the following techniques to prevent or deal with different cutting problems:

11.5.3.1 Removing the guide bar when trapped or pinched

Use the following procedure:

» Switch off the engine;

» Work partner lifts the end of the branch to open the cut;

» Withdraw the machine.

Or:

» Switch off the engine;

» Prop the engine on the ground;

» Lift and prop up the branch with a trimmed branch or pole.
11.6 Cutting attachment and saw chain

The cutting attachment consists of the saw chain, guide bar and chain drive sprocket (Figure 11-8).

Production results influenced by the cutting attachment depend on the following factors:
» Selection of the correct pole pruner, including the cutting attachment, for the task;
» Condition and maintenance of the cutting attachment.

Correct use, maintenance and repair of the cutting attachment is of critical importance and if not correct, will have a negative effect on productivity, running costs, the life of the pole pruner and operator endurance, and the quality of the work.

Saw chain manufacturers offer the correct saw chain for all cutting applications, pole pruner makes and engine capacities.

The saw chain must be maintained according to the manufacturer’s specifications to ensure safe, productive and accurate cutting. A poorly maintained saw chain is dangerous to use and will reduce the life of the saw chain and guide bar, as well as the engine.

11.6.1 Fitting of the saw chain on the pole pruner guide bar

Installation of the saw chain is similar for all pole pruners. The procedure is described in detail in the owner’s manual supplied with every pole pruner. There are however a few important points that must be noted:
» The chain length (number of drive links) must match the length of the guide bar and the drive link gauge must match the width of the guide bar groove;
» The chain pitch must match the pitch of the chain drive sprocket and the nose sprocket;
» The guide bar must be compatible with the guide bar mounting and the chain lubrication inlet holes.
A new chain drive sprocket should be installed with each new chain. However, as a chain drive sprocket normally has a wear life equivalent to two chains, it is advisable to use two chains in rotation with one sprocket. In this way, the sprocket and chain bed-in with each other and wear out together. If a new chain is installed on a half-worn sprocket, its drive links will wear very quickly.

A rule of thumb to the economic operation of a pole pruner is to use one guide bar for every two chain drive sprockets and four chains in rotation.

### 11.6.2 Chain tension

A slack or loose saw chain is the cause of most chain problems. Loose chains can:

- Climb up on the sprocket;
- Damage the guide bar rails;
- Cause wear to cutters, tie straps and the guide bar;
- Cause the chain to derail off the guide bar.

Correct tension, break-in and lubrication of the saw chain are individually and collectively of great importance to the service life of the cutting attachment. They also have a major effect on the wear of engine components.

Chain tension adjustment procedure:

- Never adjust the chain tension with the engine running;
- The cold tensioned chain should fit snugly against the underside of the guide bar so that it can still be pulled along the guide bar by hand;
- As there is much less friction on the sprocket nose type of bar, the chain can be tensioned more than on solid nose bars;
- Press the bar upwards or support it firmly from below when the chain is tensioned and bar nuts are tightened. This will prevent the bar from altering its position once cutting has started and ensure that the correct tension is maintained;
- Extreme care should be taken when checking chain tension as the cutting edges are sharp and could cause cuts. Wear both gloves when handling chain;
- During cutting, the chain warms up as a result of friction, and expands. This causes the chain to slacken and eventually sag on the underside of the bar, requiring the chain to be re-tensioned;
- Chain tension should be checked at frequent intervals in normal working conditions.

### 11.6.3 Chain lubrication

Apart from chain tension and regular care and maintenance, lubrication is the factor that has the greatest influence on the life of the cutting attachment.

Ensure that the chain lubricant never runs out before the fuel. Always refill the lubricant tank to the top. The chain lubrication system can only function if:

- The lubricant tank is filled;
The pump is in working order;
> The channels, inlet hole and the bar groove are clean.

Chain lubrication must be checked before work commences and at regular intervals during cutting. The easiest way to carry out this check, is to hold the bar tip over a light background (tree stump, sawdust, etc.) with the chain running. Chain lubrication is correct if an increasing trace of lubricant can be seen against this background.

### 11.6.4 Sharpening

The sharpening procedure is basically the same for all chains but different filing angles and settings are necessary for different chain types.

#### 11.6.4.1 Preparing saw chain for sharpening

The chain must be examined carefully for damage. Any damaged links, particularly cutters with badly nicked or chipped cutting edges, must be replaced.

The cutter with the shortest top plate must be found as it is this cutter that is used as the master for sharpening ([Figure 11-9](#)).

![Figure 11-9: Shortest top plate](image)

All cutters must be the same length and shape (balance) after sharpening. Owing to the rearward slope of the top plate, the cutter heights will be uneven if the cutter lengths are different. If the cutters are not the same height, the chain will cut roughly and may break.

After the chain has been re-sharpened, the filings can be removed from the bar groove by running the engine briefly off load at full throttle.

#### 11.6.4.2 Cutter sharpening terminology

To sharpen a saw chain the operator must understand the following:

> The side plate angle ([Figure 11-10](#)) is the angle between the side plate cutting edge and the horizontal line formed by the cutter toe and heel. This angle varies on individual chain types;
The top plate filing angle (Figure 11-11) is the angle measured from the top plate cutting edge at a right angle to the guide bar;

The filing angle differs on individual chains. The standard filing angle for normal applications is 25°- 30° as specified by the manufacturer. Wider filing angles increase cutting performance in softwood. Narrower filing angles ensure a smoother running chain and less vibration in hardwood.

The side plate angle and top plate filing angle have a significant influence on the chain's ability to cut wood and therefore it is essential to maintain the specified values.

The depth gauge is the small projection in front of the cutting edge. The difference in height between the top of the depth gauge and the leading edge of the top plate is known as the depth gauge setting (Figure 11-12). It determines the height at which the cutter enters the wood (chip thickness) and therefore has an influence on chain cutting capacity.
11.6.4.3 **Filing the chain**

Use the correct tools according to the manufacturer’s specifications. The following are needed to file the chain (Figure 11-13):

» Round file for cutters;
» File holder or file gauge for cutters;
» Flat file for the depth gauges;
» Depth gauge tool (It can be incorporated into the file gauge).

It is the operator’s responsibility to make sure the chain is in a workable and safe condition. As a general rule the chain should be sharpened after each fuel refill, and the depth gauge checked after every second fuel refill.

![Figure 11-13: Tools to sharpen the saw chain. (a) Round file and file holder; (b) Depth gauge tool; (c) Flat file; (d) Sharpening tool pouch](image)

New sharpening and depth gauge technology include devices that sharpen and adjust the depth gauge at once (Figure 11-14).

![Figure 11-14: Chain sharpening technology. a) Round file gauge, including b) depth gauge and c) all-in-one sharpener and depth gauge filer (follow suppliers' guidelines).](image)
(a) Round file cutter sharpening

Use the correct round file and file holder/gauge as prescribed by the manufacturer filing the saw chain. Sharpening with a round file is performed in such a way that the file is set with part of its diameter protruding above the top plate according to the manufacturer’s specifications (Figure 11-15). The use of a file holder/gauge ensures that the file is kept at the correct height.

Figure 11-15: Sharpening with a round file showing part of file diameter protruding

Sharpening begins at the master cutter (shortest top plate). File holders/gauges have reference lines showing the correct filing angles (Figure 11-16). Place the file holder/gauge in position. It is held so as to maintain the specific top plate filing angle required. The reference line must be parallel to the guide bar during filing.

Figure 11-16: File holder showing correct filing angle and reference lines on sharpening guide

To obtain the correct side and top plate cutting angles, the file holder must be held horizontally or at the angle specified by the manufacturer (Figure 11-17).

Figure 11-17: File holder held horizontally
Sharpen all cutters on one side of the chain first. File from the inside to the outside of each cutter. Repeat the process for cutters on the other side of the chain.

Filing must be performed on the forward stroke only. The file must be lifted off the cutter on the backstroke. To achieve smooth faces and sharp cutting edges it is necessary to file evenly and steadily. If the same number of file strokes and the same pressure is used on each cutter, cutters of similar length will be obtained. Two or three strokes of the file are usually sufficient.

**The basic rule is to file frequently and take away as little material as possible.**

**(b) Filing the depth gauge**

The depth gauge setting must be checked regularly. The settings differ according to chain pitch; therefore the correct depth gauge tool must be used. If the depth gauge projects from the depth gauge tool it must be filed down level with a flat file (Figure 11-18).

![Figure 11-18: Filing down the depth gauge](image)

If the cutters are sharpened with two to three light strokes of the round file the depth gauges do not need lowering every time. When all depth gauges are level, their front edges must be rounded to the original profile (Figure 11-19).

![Figure 11-19: Rounding the front edge of a depth gauge with a flat file](image)
11.6.4.4 Sharpening errors

The specified shape of the cutters can only be obtained if the correct tools are used (file and file holder/gauge for manual sharpening, or specially shaped grinding wheels) and the correct adjustments made.

Every deviation affects at least one of the fixed factors. For example, if the file is too thin or the file holder sets the file too low, the side plate and top plate cutting angles will be too small (a hook). Similarly, if the file diameter is too large or the file is set too high, the resultant side plate and top plate cutting angles will be too large (a back-slope).

The top plate cutting edge is the major cutting edge on the cutter. Although it is difficult to measure, it will automatically be correct if the other specified angles are maintained. Common sharpening errors include the following (Figure 11-20):

- Cutter lengths not uniform
- Irregular top plate angles
- Different side plate angles
- Uneven depth gauges

Figure 11-20: Sharpening errors on the saw chain
12. Electric pruning shears

Electric pruning shears are designed exclusively for the pruning of small tree branches, first reduction coppice regrowth, vines, shrubs and bushes. The unit will generally comprise of hand held shears powered by an electrically driven hydraulic system carried on the back of the operator.

This power tool should never be used for any other purpose other than what it has been designed for, due to the increased risk of accidents and damage to the power tool itself. Never attempt to modify the electric pruning shear in any way since this may increase the risk of personal injury.

12.1 External components

The unit comprises of a hand held shear (Figures 12-1 a and b) with an ergonomically attached battery backpack/harness carried on the back of the operator (Figures 12-1 c-f).

Figure 12-1: External components of the manual assisted shears (a and b) harness (c) hand protective gloves (d) and working stance of shear operator (e). Ergonomically designed harness with insulated battery pack (f)
12.2  Personal protective equipment

Due to the electric pruning shears being traditionally used to cut branches off trees, PPE requirements are important and specific to this type of machinery. PPE will not eliminate the risk of injury but will reduce the effects in the event of an accident.

General considerations when using electric shears include the following:

» Clothing must be sturdy but allow complete freedom of movement;
» Avoid clothing that could get caught in scrub or moving parts of the power tool. Do not wear a scarf, necktie or jewellery. Tie up and confine long hair;
» Wear sturdy shoes with non-slip soles;
» Wear heavy-duty work gloves made of durable material (e.g. leather) or non-cut safety gloves as provided by the OEM especially when using short handle shears and when the operators hands are close to the object being cut. Details regarding these gloves or mitts can be found in Section 12.2.4;
» To reduce the risk of eye injuries, wear snug-fitting safety glasses.

12.2.1 Safety helmet

Due to the application of pruning shears, potentially working under a tree canopy or working with the risk of branches or other vegetative material falling on the operator, a safety helmet is required at a minimum when working under the canopy. The specifics of the safety helmet are found in Section 5.3.1.

In other applications of this machine, when working in the open, a sun hat is recommended where there is no risk of falling objects.

12.2.2 Eye protection

Safety glasses may be recommended when using mechanically assisted shears. Visors attached to safety helmets (when used) can sufficiently fulfil this safety aspect. Details of minimum requirements for eye protection are found in Section 5.3.3.

12.2.3 Hearing protection

When using mechanically assisted shears the operator is not required to wear hearing protection (due to the lack of loud noise emitted from the device). However, if the shears are being used in conjunction with other operations that emit loud noise (i.e. chainsaws, brush cutters or clearing saws) hearing protection is advised. Ensure that the hearing protection complies with guidelines in Chapter 5.3.2.

12.2.4 Gloves/mitts

The use of gloves/mitts used while operating handheld shears depends on how close the operators hands are to the object being cut. Sturdy tight fitting gloves with a wrist strap should be worn, giving the operator a good feel and grip on the shears. These should preferably be made of leather. Ensure that the gloves are replaced when worn or as per manufacturers specifications at all times.
There are specific manufacturers that supply a specialised safety glove that is worn on the non-working hand that will inactivate the shearing mechanism of the blade should the glove/hand come into contact with the shearing components (See Figure 12-1). This is particularly important for the short handled version of the electric shear where the operator’s hand may come into contact with the cutting mechanism of the tool during pruning.

For the longer handled and more widely used shear the use of a protective glove is not necessary as the operator’s non-working hand cannot reach the cutting mechanism of the tool whilst in operation.

### 12.2.5 Leg protection

Strong durable trousers should be worn as a minimum.

### 12.2.6 Footwear

Appropriate safety boots with adequate steel toe protection to provide protection against rolling objects should be used. These boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support. Lace-up types must be securely fastened to prevent tripping over laces.

### 1.1 General safety considerations when using manually assisted electric pruning shears

The operator needs to be adequately trained and assessed to be competent as an electric pruning shear operator before he/she can operate.

Consider the following:

- Special safety precautions must be observed when working with an electric pruning shear because the blade is very sharp;
- Cautionary warning for persons with pacemakers: The machine’s electronic control system may interfere with some pacemakers. To reduce health risks persons with pacemakers are to consult their physician and the pacemaker manufacturer before operating this power tool;
- Never touch the blades while the power tool is connected to the battery;
- Switch off your pruning shears and disconnect the connecting cord:
  - before carrying out inspections, adjustments or cleaning work;
  - before performing repairs and maintenance work;
  - in the event of danger or in an emergency.
- This avoids the risk of the cutting blade closing unintentionally;
- Do not use the connecting cord to pull, hang up or transport your electric pruning shears;
- Do not operate the power tool with a damaged connecting cord or plug;
- Straighten a twisted connecting cord before use;
- Avoid chafing, pinching or tugging the connecting cord – risk of damage;
- Protect from heat, oil, pointed objects, sharp edges and the blades;
- If the backpack emits fumes, heats up, smells or makes noises, remove it from the back, disconnect the connecting cord from the power tool and immediately move a safe distance away;
Keep the backpack away from combustible materials;

» Do not place the backpack on raised surfaces or hang it up (e.g. on branches) it may fall down;

» Never sit or stand on the backpack. Do not stand objects on the backpack;

» For emergencies, practice quickly opening the buckles on the waist belt (1) and chest strap (2), loosening the shoulder straps and setting down the backpack (Figure 12-2);

» To avoid damage, do not throw the backpack to the ground when practicing.

![Figure 12-2: Quick release strategy for removing backpack](image)

12.3 Other accessories and tools required

The clearing saw operator should be equipped with the following:

» Files to sharpen the shears;

» Cloth/brush for cleaning shears;

» Whistle to be carried for emergencies.

The following equipment and tools should be available on site:

» First aid kit in close proximity;

» Radio or mobile phone for emergency contacts;

» Fire extinguisher.

12.4 Operating the manually assisted electric pruning shears

In order for safe and ergonomic operation the following steps need to be adhered to:

12.4.1 Carrying and moving the powered shears

» Carry the backpack on the back or by the handle;

» Transport the cordless pruning shears in the holster;

» Do not carry it hanging from the connecting cord;

» Transporting short distances during cutting work:
  • Always close the cutting blade, i.e. standby mode;
  • Put your cordless pruning shears in the holster.

» Transporting over longer distances (Figure 12-3):
  • Always close the cutting blade, i.e. standby mode;
  • Move switch on controller to OFF;
• Disconnect the connecting cord from the power tool;
• Put the cordless pruning shears in the holster.

![Figure 12-3: Carrying the pruning saw long distances](image)

Always remove the battery from the battery bag when transporting the power tool to and from the work area and in vehicles.

**12.4.2 Before using the pole pruner**

Pay special attention to the following parts of the pruning shears:
- Cutting and anvil blades properly assembled;
- Correct play between cutting and anvil blades;
- Cutting and anvil blades in good condition;
- Trigger moves freely;
- The handle is clean, dry and free from oil and dirt.

Pay special attention to the following parts of the backpack:
- Battery correctly fitted and secured with the strap;
- Backpack in good condition;
- Harness in good condition;
- Connecting cord, plug and controller in good condition;
- Never use defective or deformed batteries.

**12.4.3 During pole pruner operation**

- Wear the backpack under a jacket in cold or wet weather conditions. Dry off the power tool after finishing work. Do not leave the power tool on the ground or in the wet;
- Take special care in slippery conditions, on slopes or uneven ground;
- Watch out for tree stumps, roots and rocks which could cause the operator to stumble or fall;
- To reduce the risk of accidents, take a break in good time to avoid tiredness or exhaustion;
- Work calmly and carefully – in daylight conditions and only when visibility is good. Stay alert so as not to endanger others;
- The power tool is operated by one person only. Do not allow any other persons in the work area;
- Make sure the operator observes the blades at all times and only cut in areas where the blades are visible to the operator;
» Be extremely careful when cutting dense rows of plants, check the other side before starting work;
» To avoid the risk of electrocution, do not touch electric power lines – never cut through electric power lines;
» When working at heights:
  • Always use a lift bucket
  • Never work on a ladder or in a tree
  • Never work on an insecure support
» Never hold a branch with a free hand directly next to the point a cut is to be made. Always maintain a distance of at least 40cm from the blades. Never touch the cutting blade as it is very sharp;
» Be wary of flying or splintering material;
» Clear away fallen branches, scrub and cuttings only when the cordless pruning shears are in the standby mode and fitted in the holster;
» In the event of danger or an emergency, switch off the power tool immediately and disconnect the connecting cord;
» If the power tool is subjected to unusually high loads for which it was not designed (e.g. heavy impact or a fall), always check that it is in good condition before continuing work. Make sure the safety devices are working properly. Do not continue using a power tool that is not in a safe operating condition. In case of doubt, consult the servicing dealer.

12.4.4 Storing the shears
When the power tool is not in use, put it in a place where it does not endanger others. Secure it against unauthorized use by:
» Always closing the cutting blade, i.e. standby mode;
» Moving the switch on controller to the OFF position;
» Disconnecting the connecting cord from the power tool;
» Placing the cordless pruning shears in the holster;
» Removing the battery.

12.4.5 Good operating technique
Correct operating technique ensures safe and productive operating. Good technique for effective operating include the following:

12.4.5.1 Holding and controlling the power tool
Consider the following:
» The backpack is worn on the user’s back;
» Hold the pruning shears firmly in the right or left hand. Wrap the thumb firmly around the handle housing for good control. Do not touch any moving parts of the pruning shears with the fingers. Operate the trigger with the index finger (Figure 12-4);
» Check that the connecting cord is properly and securely fitted and not snagged;
» Ensure a firm footing when making cuts.
12.4.5.2 Cutting

To save energy, pre-set the cutting blade’s opening angle to the branch diameter to be cut.

To avoid damage to the cutting mechanism during operation:

» Clear away pieces of metal and solid objects from the work area;
» When working close to the ground, make sure that no sand, grit or stones get between the blades;
» Do not touch or cut wire fences or wire with the blades;
» Check the sharpness of the cutting blade at regular intervals;
» Do not swing the pruning shears sideways whilst cutting;
» Do not use force on the trigger when depressing it.

The housing of the pruning shears can become hot during intensive use or while cutting heavier growth. In such a case, reduce working speed or cutting diameter. The electronic control system reduces cutting performance if the pruning shears become too hot.

Check the condition and tightness of the cutting and anvil blades:

» If the cut is no longer clean or effortless;
» If there is a noticeable change in behaviour of the shears;
» If the blades become blocked.

12.4.5.3 Releasing blockages

In order to release blockages consider the following:

» If the branch diameter is too large, the cutting blade locks in position during closing;
» If the pruning shears are jammed in the cut, do not switch them off at the controller since mechanical parts may otherwise be damaged during removal from the wood;
» To release the blockage, always leave the pruning shears switched on and remove them from the wood as shown in Figure 12-5;
» To reduce the risk of injury, do not touch the blades.
12.4.6 Sharpening the cutting blade

The sharpness of the cutting blade influences the quality of the cut. The re-sharpening frequency depends on the hardness and diameter of the wood being cut and the cutting rhythm. Check the sharpness of the cutting blade at regular intervals.

12.4.6.1 Sharpening intervals

When using the pruning shears for the first time or after changing the blade, check and re-sharpen the blade after the first half hour of operation. Also check the play between the cutting and anvil blades and readjust if necessary. Check the sharpness of the blade at regular intervals and re-sharpen it in good time. A visual check every quarter of an hour quickly establishes a feeling for how often the blade needs re-sharpening. During the cutting season, sharpen the blade as required, but at least once a day.

12.4.6.2 Sharpening the cutting blade

Sharpen the blade with a whetstone with the shears open and sharpen on both sides of the blade (Figure 12-6).
12.4.6.3 Adjusting play between cutting and anvil blades

Play must be readjusted when the cutting blade can be pushed sideways away from the anvil blade. This can be done in the following way:

1) Loosen the screw (1) on the locking segment (2).

2) Fit setting tool (3) on adjusting nut (4). Carefully tighten the adjusting nut (4) until the cutting blade (5) can no longer be pushed away from the anvil blade and there is no play.

3) Tighten down the screw (1) on the locking segment (2).
12.4.6.4 Minimize wear and avoid damage
Observing the instructions in this manual as well as the operator’s manual helps reduce the risk of unnecessary wear and damage to the power tool. The power tool must be operated, maintained and stored with the due care and attention described in the instruction manuals. The user is responsible for all damage caused by non-observance of the safety precautions, operating and maintenance instructions. This includes in particular:

» Alterations or modifications to the product not approved by the manufacturer;
» Using tools or accessories which are neither approved nor suitable for the product or are of a poor quality;
» Using the product for purposes for which it was not designed;
» Using the product for sports or competitive events;
» Consequential damage caused by continuing to use the product with defective components.

12.4.6.5 Maintenance work
All the operations described in the section on “Maintenance and Care” must be performed on a regular basis. If these maintenance operations cannot be performed by the owner, they should be performed by a servicing dealer.

If regular maintenance operations are not carried out as specified damage may occur which among other things include:

» Damage to the cutting mechanism and parts due to inadequate maintenance (e.g. lubrication and adjustments described in the instruction manual);
» Damage to the charger caused by incorrect electrical connection (voltage);
» Corrosion and other consequential damage to the power tool, battery and charger due to improper storage and use;
» Damage to the product resulting from the use of poor quality replacement parts.

12.4.6.6 Parts subject to wear and tear
Some parts of the power tool are subject to normal wear and tear even during regular operation in accordance with instructions and, depending on the type and duration of use, have to be replaced in good time. Among other parts, this includes:

» Parts of the cutting mechanism subjected to high mechanical loads, e.g. cutting and anvil blades, pivot pin;
» Battery.

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13. Powered chemical knapsacks

Powered chemical knapsacks are outdoor power equipment used to apply chemicals to undesired vegetation for the majority of the time they are operational. The unit comprises of a knapsack to hold chemicals and a pump to pump the chemical out of a lance onto vegetation. These units can either be petrol powered or battery operated.

13.1 External components of a powered knapsack

The powered knapsack comprises of the following parts (Figure 13-1):

![Components of a powered chemical knapsack](image)

<table>
<thead>
<tr>
<th></th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuel primer</td>
</tr>
<tr>
<td>2</td>
<td>Air filter cover</td>
</tr>
<tr>
<td>3</td>
<td>Choke lever</td>
</tr>
<tr>
<td>4</td>
<td>Fuel tank</td>
</tr>
<tr>
<td>5</td>
<td>Starter handle</td>
</tr>
<tr>
<td>6</td>
<td>Throttle lever</td>
</tr>
<tr>
<td>7</td>
<td>Stop switch</td>
</tr>
<tr>
<td>8</td>
<td>Spray lance</td>
</tr>
<tr>
<td>9</td>
<td>Hand grip</td>
</tr>
<tr>
<td>10</td>
<td>Pressure regulator</td>
</tr>
<tr>
<td>11</td>
<td>Tank drain valve</td>
</tr>
</tbody>
</table>

13.1.1 Powered chemical knapsack design

Powered chemical knapsacks are designed to be carried on the back of an operator for ergonomic and safe use (Figure 13-2). Note: PPE requirements differ according to type of chemical and application, please consult the chemical MSDS for exact PPE requirements.
13.1.2 Powered chemical knapsack set up

Ensure that the shoulder straps are secure on the back of the operator and the unit does not move around unnecessarily (Figure 13-3).

Figure 13-2: The working stance of the operator with appropriate PPE when using a powered chemical knapsack

Figure 13-3: Powered chemical knapsack on the back of the operator
When setting up the sprayer use the following procedure (Figure 13-4):

Connect the spray hose to the pump spray outlet and firmly tighten the connecting nut;

» Tightly screw the joint onto the hose;
» Tightly screw the grip onto the hose;
» Tightly screw the cock onto the grip;
» Tightly screw the rod onto the cock;
» Tightly screw the spray rod onto the rod.

![Diagram of setting up the powered knapsack](image)

**Figure 13-4: Setting up the powered knapsack**

Adjust the spray pressure by turning the regulating dial on the side of the unit to the appropriate pressure for the spraying operation (Figure 13-5):

» Turn the dial clockwise to increase the pressure and;
» Counter clockwise to decrease the pressure.

![Diagram of pressure setting](image)

**Figure 13-5: Pressure setting on the powered knapsack**
13.2 Personal protective equipment

Due to the chemical knapsack being used to apply chemicals, PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an accident. Refer to the Material Safety Data Sheet (MSDS) for PPE requirements of the particular chemical being applied.

13.2.1 Safety helmet

The use of a safety helmet depends on the situation where the operation is taking place. Usually safety helmets are only recommended when working under a tree canopy. This helmet is either fitted with ear protection and visor or without. The specifics of the safety helmet are found in Section 5.3.1.

In most applications of this machine, a sun hat is recommended as most operations will be done working in the open with no risk of falling objects.

13.2.2 Eye protection

Chemicals can severely affect the eyes of the operator therefore suitable goggles must be worn when mixing and applying chemicals. It is advisable to follow the operator’s manual for details regarding this.

Adhere to the following:
- Use only EN 1731 standard approved goggles;
- Replace when damaged or as per manufacturer’s instructions;
- Maintain and clean when required.

13.2.3 Hearing protection

Powered chemical knapsacks do not emit noise levels to warrant the use of hearing protection.

13.2.4 Gloves

Sturdy elbow length gloves should be worn, giving the operator a good feel and grip on the controls. These should preferably be made of rubber. Ensure that the gloves are replaced when worn, or perforated, as per manufacturers specifications.

13.2.5 Leg protection

Strong durable overalls should be worn as a minimum. A plastic/rubber apron is advisable to be worn.

13.2.6 Footwear

Use sturdy boots.

13.2.7 Mask/respirator

Breathing in chemicals is extremely hazardous therefore the correct mask or respirator must be used as per Material Safety Data Sheet (MSDS)
13.2.8 Protective barrier cream

It is advisable to apply a barrier cream to prevent chemicals coming into contact with the exposed areas of the operator’s skin.

13.2.9 Additional PPE

In addition to all the above the operator should have immediate access to clean water, domestic soap and a towel to clean away any chemical that may have come into contact with the operator’s skin.

13.3 Carrying and moving the knapsack sprayer

When moving the sprayer long distances or transporting the sprayer, always adhere to the following:

» Ensure that the sprayer is switched off;

» Do not transport the sprayer while it has chemicals in the tanks as these could leak out as a result of impact during transportation.

» In the case of transporting the sprayer in a vehicle make sure that it is firmly fixed to the vehicle in an upright position.

13.4 Before using the sprayer

Consider the following before using the sprayer:

13.4.1 The environment

Do a pre-operational risk assessment on the area in which spraying will take place to ensure that the water supply, rivers, dams, ponds etc. are not polluted.

13.4.2 Pre-work safety checks

In order to ensure that the sprayer is safe and fit for the day ahead the operator should inspect and ensure that:

» All the components of the engine are secure and are not damaged;

» The on/off switch works;

» The throttle control works;

» All spray nozzles, hoses and connections do not leak or have any other defects;

» Gaskets on the tank lid are not leaking;

» The harness is in good working order;

» The valve on the spray lance does not leak;

» The lids on the chemical tank and fuel tank are secured and do not leak;

» The Anti-vibrations springs are not damaged;

» There are no people or animals in the area that is to be sprayed.

13.4.3 Starting (petrol driven models)

The machine can be started cold first thing in the day or after a long break or warm when the engine has been off for a short time.

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Cold start procedure:

» Turn the on/off switch to the start position;
» Put the choke control in the choke position;
» Squeeze the primer fuel pump bulb (the bulb doesn’t need to completely fill).

The warm start procedure is to follow the same procedure as a cold start procedure, except do not choke the machine.

To start the machine:

» Make sure no one is in the working area (safety distance of 15m);
» The stop valve on the lance is in the closed position;
» Place the machine on the ground so that the blade is clear of the ground and other objects;
» Grab the starter handle with your right hand and pull the cord until you feel some resistance, then pull the cord with a vigorous motion;
» If a cold start, turn off the choke once the engine fires and pull the starter cord to start the machine;
» Set the throttle in the desired position;
» To stop the engine use the engine stop switch.

**IMPORTANT:**
- Never wrap the starter cord around your hand;
- Do not pull the cord all the way out and do not let go of the start handle when pulled all the way out. This will damage the starter mechanism.

### 13.4.4 Refuelling

The following procedure should be followed when refuelling a powered sprayer:

» Use a fuel container with overflow protection to avoid spills (Figure 16-1);
» Wipe the fuel cap clean to prevent contamination of the fuel in the tank;
» Open the fuel cap carefully;
» Shake the fuel in the fuel container to ensure a proper mix of oil and fuel;
» Close the fuel cap carefully;
» Wipe any spillage that may occur;
» Start the machine at least 3m away from refuelling area for safety.

### 13.5 Using the knapsack

Fatigue reduces powers of concentration and increases the risk of accidents. When planning work allow ample time, 30-40 minutes, for a single spraying session and breaks of 10-20 minutes in between. If spraying for more than two hours a day the operation should be shared between two operators.

#### 13.5.1 Good operating technique

Correct operating technique ensures safe and productive operating. Good technique for effective operating include the following:
Always start the engine when it is on the ground then lift it onto your back;
Adjust the harness to suit the application and the operator;
Always have the throttle/revs set according to the task at hand (refer to the operator’s manual);
When the revs are set, open the stop valve and begin spraying;
After spraying close the stop valve and reduce the engine revs to the idle position.

13.5.2 Procedure for filling
Follow the following procedure when filling the sprayer:
Always wear the appropriate PPE when working with chemicals
Use a bucket or other suitable container and dilute the chemical to the specified concentration/strength;
Place the sprayer on an even and stable surface and remove the chemical tank cap;
Fill the tank by pouring the chemical through the strainer/sieve;
When filling is complete, firmly tighten the cap and check that it is sealed.

13.6 Operating the knapsack productively
The following information serves as a guide to a productive operating technique.

13.6.1 Work methodology and planning
Ensuring that the sprayer will be used productively, firstly, be aware of the following environmental conditions:
Slope: Caution is to be exercised on steep slippery slopes. It is preferable to work up the slope where conditions are very steep;
Rocky areas: Caution is to be exercised in rocky areas as there is a danger of tripping and falling.

The operator should be aware of and practice the following:
The correct equipment must always be selected for the task; this significantly reduces risk and improves productivity;
Ensure sound footing and a stable posture;
Be aware of wind direction and always work upwind to avoid the chemical spraying onto the operator;
Should the operator begin to feel even slightly unwell while spraying, consult a doctor immediately. Inform the doctor of the name of the chemical being used and what the conditions were at the time;
Do not allow chemical or water in the tank to run out while the engine is running as this may cause damage to the pump.

Delays should be avoided by ensuring the following:
Sufficient fuel and lubricant is available for the shift;
Plan refuelling so as to avoid walking long distances to refuel;

13.6.2 Cleaning after spraying
Loosen the fluid drain cap, drain the chemical that is left inside the tank into a suitable container and process appropriately with all due consideration to industry and company safety standards and policies;
Pour about 5 litres of clean water into the chemical tank and spray through the nozzle for 2-3 minutes and then drain the remainder of the water;
Repeat the previous step but this time rinse with a 5% ammonia solution in the water.
13.7 Precautions after spraying

Adhere to the following guidelines when spraying is complete for the day or shift:

13.7.1 Safety checks

Ensure the correct safety checks are done after spraying:

» Seal unused chemical containers and keep them out of reach of untrained personnel or children;
» Discard empty chemical containers according to company policy;
» Fully inspect all PPE and repair or discard before the next session of work;
» Carefully store all chemicals and spraying equipment according to company policy;
» Immediately after work the operator should take a bath/shower or thoroughly wash hands, feet, face etc. with soap as well as washing out the mouth;
» All clothing, including under-wear should be washed before being used again;

13.7.2 Other precautions

The following precautions should be taken into account:

» When engaged in spraying activities over a protracted period of time have the operators health checked regularly;
» Only work according to the prescribed spraying plan and method;
» **Storage**: When storing the sprayer ensure that all the cleaning after spraying procedures are complied with;

13.8 Storage

Refer to the operator’s manual with regard to specific storage procedures. The following should be adhered to:

» Clean the chemical tank as per Chapter 13.6.2;
» Thoroughly check the unit for any missing or damaged components, nuts or bolts and have them attended to before putting the unit away;
» Drain the fuel tank;
» Start the engine and run it until all the fuel left in the system runs out;
» Remove the spark plug and pour in a few drops of two stroke engine oil into the cylinder and replace the spark plug. Turn the engine over until the compression stroke can be felt;
» After oiling the throttle lever and spraying the other metal parts with an anti-corrosive oil, cover the sprayer and store in a low humidity location.

13.9 Battery powered chemical knapsacks

The same procedures of the petrol sprayer apply to battery powered chemical knapsacks with the exception of the engine component. Here certain rules pertaining to the battery will apply:

» Replace a leaking or faulty battery and dispose of according to government, industry and company regulations and guidelines in Chapter 5.2.3;
» Ensure that the operator has sufficient battery power to complete the task;
» The unit must not be stored with the battery attached;
» Charging of the batteries should take place in a well ventilated area away from people and animals.

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14. Chemical mist blowers

Chemical mist blowers are outdoor power equipment used to apply high velocity air and chemical mist to vegetation most of the time it is operational. The unit comprises of a knapsack based low pressure pump, and chemical tank with a large hose to direct the mist to the focus of the work.

14.1 External components

The chemical mist blower consists of the following parts (Figure 14-1):

![Figure 14-1: Components of the chemical mist blower](image)

<table>
<thead>
<tr>
<th>Number</th>
<th>Component</th>
<th>Number</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Container cap</td>
<td>16</td>
<td>Nozzle</td>
</tr>
<tr>
<td>2</td>
<td>Container</td>
<td>17</td>
<td>Blower tube</td>
</tr>
<tr>
<td>3</td>
<td>Lever</td>
<td>18</td>
<td>Throttle trigger</td>
</tr>
<tr>
<td>4</td>
<td>Metering unit</td>
<td>19</td>
<td>Control handle</td>
</tr>
<tr>
<td>6</td>
<td>Spark plug boot</td>
<td>20</td>
<td>Setting lever</td>
</tr>
<tr>
<td>7</td>
<td>Carburettor adjusting screw</td>
<td>21</td>
<td>Valve lever for solution feed</td>
</tr>
<tr>
<td>8</td>
<td>Choke knob</td>
<td>22</td>
<td>Throttle trigger lock out</td>
</tr>
<tr>
<td>9</td>
<td>Starter grip</td>
<td>23</td>
<td>Metering lever for dusting and spreading mode</td>
</tr>
<tr>
<td>10</td>
<td>Fuel filler cap</td>
<td>24</td>
<td>Pleated hose</td>
</tr>
<tr>
<td>11</td>
<td>Fuel tank</td>
<td>25</td>
<td>Harness</td>
</tr>
<tr>
<td>12</td>
<td>Muffler with spark arrestor screen</td>
<td>26</td>
<td>Back plate</td>
</tr>
<tr>
<td>13</td>
<td>Anti-static system</td>
<td>27a</td>
<td>Back padding small</td>
</tr>
<tr>
<td>14</td>
<td>Baffle screen</td>
<td>27b</td>
<td>Back padding large</td>
</tr>
<tr>
<td>15</td>
<td>Metering knob</td>
<td>28</td>
<td>Intake screen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>29</td>
<td>Air filter</td>
</tr>
</tbody>
</table>
14.1.1 Chemical mist blower design

The powered chemical mist blower is designed to be held and supported by a backpack harness attached to the operator for ergonomic and safe use (Figure 14-2). Note: PPE requirements differ according to type of chemical and application, please consult the chemical MSDS for exact PPE requirements.

Figure 14-2: The working stance of the operator using a chemical mist blower with appropriate PPE

14.1.2 Setting up the chemical mist blower

In order to ensure safe and comfortable operation of the blower the following steps should be taken to fit it properly:

» Adjust the harness straps so that the back-plate fits snugly and securely against your back, by adjusting the height (A) and angle (B) of the straps (Figure 14-3);

Figure 14-3: Adjusting the blower straps

» To tighten the straps, pull the ends of the adjusting strap/sliding adjusters downward;
» To loosen the straps, lift the tabs of the sliding adjusters;
» Ensure that the unit fits comfortably on the operator (Figure 14-4).
14.2 Personal protective equipment

Due to the chemical mist blower being used to apply chemical, PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an accident.

14.2.1 Safety helmet

The use of a safety helmet depends on the situation where the operation is taking place. Usually safety helmets are only recommended when working under a tree canopy. This helmet is either fitted with ear protection and visor or without. Due to the noise emitted from the mist blower unit, hearing protection is necessary. The specifics of the safety helmet are found in Section 5.3.1.

In most applications of this machine, a sun hat is recommended as most operations will be done working in the open with no risk of falling objects.

14.2.2 Eye protection

Small blown objects can severely affect the eyes of the operator, for this reason suitable goggles must be worn when operating the unit. It is advisable to follow the operator’s manual for details regarding this.

Adhere to the following:

» Use only EN 1731 standard approved goggles;
» Replace when damaged or as per manufacturer’s instructions;
» Maintain and clean when required.
14.2.3 **Hearing protection**
Separate earmuffs can be used, as generally a sun hat is required when working in the open. Ensure that the hearing protection complies with guidelines in Chapter 5.3.2.

14.2.4 **Gloves/mitts**
Sturdy tight fitting PVC gloves should be worn, giving the operator a good feel and grip on the handle. Ensure that the gloves are replaced when worn or as per manufacturers specifications.

14.2.5 **Leg protection**
Strong durable overalls should be worn as a minimum. A plastic/rubber apron is advisable to be worn.

14.2.6 **Footwear**
Appropriate safety boots with adequate steel toe protection to provide protection against the falling objects and rocks should be used. These boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support and an adequate level of cut resistance. Lace-up types must be securely fastened to prevent tripping over laces.

14.2.7 **Mask/respirator**
Breathing in chemical is extremely hazardous therefore the correct mask or respirator must be used as per Material Safety Data Sheet (MSDS).

14.2.8 **Protective barrier cream**
It is advisable to apply a barrier cream to prevent chemical coming into contact with the exposed areas of the operator's skin.

14.2.9 **Additional PPE**
In addition to all the above the operator should have immediate access to clean water, domestic soap and a towel to clean away any chemical that may have come into contact with the operator's skin.

14.3 **Carrying and moving the blowers**
Always carry the blower as a backpack and not with the straps over one shoulder. Always switch off the blower when moving it over a long distance.

14.4 **Before using the blowers**
Ensure that the following is checked before using the chemical mist blower:

14.4.1 **The environment**
Pay all due consideration to the area in which spraying will take place to ensure that the water supply, rivers, dams, ponds etc. are not polluted.
14.4.2 Pre-start safety checks

In order to ensure that the chemical mist blower is safe and fit for the day ahead, the operator should inspect and ensure that:

- All the components of the engine are secure and not damaged;
- The on/off switch works;
- The throttle control works;
- All spray nozzles, hoses and connections do not leak or have any other defects;
- Gaskets on the tank lid are not leaking;
- The harness is in good working order;
- The valve on the spray lance does not leak;
- The lids on the chemical tank and fuel tank are secured and do not leak;
- The Anti-vibrations springs are not damaged;
- There are no people or animals in the area to be sprayed.

14.4.3 Starting

To start the blower, follow the following procedure:

- Place the unit securely on the ground and make sure that bystanders are well clear of the mist blower outlet;
- Make sure you have a firm footing: Hold the unit with your left hand on the housing and put one foot against the base plate to prevent it slipping;
- Pull the starter grip slowly with your right hand until you feel it engage and then give it a brisk strong pull. Do not pull out the starter rope to full length – it might otherwise break;
- Do not let the starter grip snap back. Guide it slowly back into the housing so that the starter rope can rewind properly;
- Crank the engine until it begins to fire. After no more than three attempts, turn the choke knob to “N” when engine begins to run.

If the engine is cold:

- Turn the choke knob to “N” and continue cranking until the engine runs.

If the engine is warm:

- Continue cranking until the engine runs.

- As soon as the engine runs return engine to idle speed, operate the throttle trigger and the choke knob will automatically move to the run position.

14.4.4 Refuelling

Refuelling should be done in an area that has been cleared of debris to prevent accidental fire. Do not smoke while refuelling. More details on refuelling can be found in Section 16.2.
14.5 Operating the blower

The blower is designed for single-handed operation with the right hand on the control handle. It should be carried as a backpack with the straps of the harness over both shoulders.

14.5.1 Holding the mist blower

Wrap the fingers tightly around the handle, keeping the control handle cradled between the thumb and forefinger (Figure 14-5). Keep the hand in this position to have the machine under control at all times.

Figure 14-5: Holding and operating the mist blower

14.5.2 Operating the blower productively

Work methodology and planning ensure that the blower will be used productively. Firstly, be aware of the following environmental conditions:

» Slope: Caution is to be exercised on steep slippery slopes. It is preferable to work up the slope where conditions are very steep.

The operator should be aware of and practice the following:

» The correct equipment must always be selected for the task; this significantly reduces risk and improves productivity;
» Ensure sound footing and a stable posture;
» The blow pattern is determined by the density of the canopy, wind direction and undergrowth.
» Delays should be avoided by ensuring the following:
  • Sufficient fuel and lubricant is available for the shift;
  • Plan refuelling so as to avoid walking long distances to refuel;
15. Blowers used for Fire Management

Blowers are outdoor power equipment using high velocity air to blow clear areas and are used for fire suppression for most of the time they are operational.

15.1 External components

The unit comprises of the following components (Figure 15-1):

![Figure 15-1: Components of the fire blower unit](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Frame</td>
<td>15</td>
<td>Stop switch</td>
</tr>
<tr>
<td>2</td>
<td>Harness</td>
<td>16</td>
<td>Throttle trigger</td>
</tr>
<tr>
<td>3</td>
<td>Engine cover</td>
<td>17</td>
<td>Handlebar (accessory)</td>
</tr>
<tr>
<td>4</td>
<td>Fan shell</td>
<td>18</td>
<td>Elbow</td>
</tr>
<tr>
<td>5</td>
<td>Air intake screen</td>
<td>19</td>
<td>Clamp</td>
</tr>
<tr>
<td>6</td>
<td>Fan</td>
<td>20</td>
<td>Flexible hose</td>
</tr>
<tr>
<td>7</td>
<td>Air filter</td>
<td>21</td>
<td>Control pipe</td>
</tr>
<tr>
<td>8</td>
<td>Starter handle</td>
<td>22</td>
<td>Clamp</td>
</tr>
<tr>
<td>9</td>
<td>Fuel tank</td>
<td>23</td>
<td>Intermediate pipe</td>
</tr>
<tr>
<td>10</td>
<td>Pad</td>
<td>24</td>
<td>Blow pipe</td>
</tr>
<tr>
<td>11</td>
<td>Spark plug</td>
<td>25</td>
<td>Flat nozzle (accessory)</td>
</tr>
<tr>
<td>12</td>
<td>Vibration damping system</td>
<td>26</td>
<td>Operators manual</td>
</tr>
<tr>
<td>13</td>
<td>Choke control</td>
<td>27</td>
<td>Combination spanner</td>
</tr>
<tr>
<td>14</td>
<td>Control handle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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15.1.1 Fire management blower

The fire suppression blower is designed to be held and supported by a backpack harness worn by the operator for ergonomic and safe use.

15.1.2 Setting up the fire management blower

In order to ensure safe and comfortable operation of the blower the following steps should be taken to fit it properly:

» Adjust the harness straps so that the back plate fits snugly and securely against your back, by adjusting the height (A) and angle (B) of the straps (Figure 15-2);

![Figure 15-2: Adjusting the blower straps](image)

» To tighten the straps, pull the ends of the adjusting strap/sliding adjusters downward;

» To loosen the straps, lift the tabs of the sliding adjusters;

» Ensure that the unit fits comfortably on the operator (Figure 14-3).

![Figure 15-3: Correctly fitted unit on the operator](image)
15.2 Personal protective equipment

PPE requirements are important and specific to this type of machinery. PPE does not eliminate the risk of injury but does reduce the effects in the event of an accident.

All following PPE must be aligned with PPE requirements for firefighting operations & PPE requirements for the equipment used.

15.2.1 Safety helmet

The use of a safety helmet depends on the situation where the operation is taking place. Usually safety helmets are only recommended when working under a tree canopy. This helmet is either fitted with ear protection and visor or without. Due to the noise emitted from the blower engine, hearing protection is necessary. The specifics of the safety helmet are found in Section 5.3.1.

For firefighting, a helmet with earmuffs needs to be worn, the earmuffs can be fitted with an integrated radio for communications as an option.

15.2.2 Eye protection

Small blown objects can severely affect the eyes of the operator, for this reason suitable goggles must be worn operating the unit.

Adhere to the following:

» Use only EN 1731 standard approved goggles;
» Replace when damaged or as per manufacturer’s instructions;
» Maintain and clean when required.

UVEX Fire-UVEX Fire-fighter goggles are recommended

15.2.3 Hearing protection

Hearing protection is usually attached to the safety helmet; additional hearing protection may be used in the form of earplugs. Ensure that the hearing protection complies with guidelines in Chapter 5.3.2.

15.2.4 Gloves/mitts

Sturdy tight fitting gloves with a wrist strap should be worn, giving the operator a good feel and grip on the handle. These should preferably be made of leather and be rated for firefighting. Ensure that the gloves are replaced when worn or as per manufacturers specifications.

15.2.5 Clothing

Flame retardant overalls with reflective strips should be worn to minimise risks while managing the fire. A Nomex fire hood can also be work for the comfort of the operator.
15.2.6 Footwear
Appropriate safety boots with adequate steel toe protection to provide protection against falling objects and rocks should be used. These boots should be sturdy with steel mid-sole and non-slip soles that provide firm ankle support and an adequate level of cut resistance. Lace-up types must be securely fastened to prevent tripping over laces.

15.2.7 Mask
To reduce the risk of injury and inhalation of dust, smoke or other blown debris, a suitable and approved respirator and goggles should be used.

15.3 Carrying and moving the blowers
Always carry the blower as a backpack and not with the straps over one shoulder. Always switch off the blower when moving it over a long distance.

15.4 Before using the blowers
Ensure that the following is checked before using the chemical mist blower.

15.4.1 Pre-start safety checks
In order to ensure that the blower is safe and fit for the day ahead the operator should inspect and ensure that:
- All the components of the engine are secure and not damaged;
- The on/off switch works;
- The throttle control works;
- The harness is in good working order;
- The Anti-vibrations springs are not damaged;
- There are no fuel leaks;
- All fuel hoses are inside the protective housing.

15.4.2 Starting
To start the blower, follow the following procedure:
- Place the unit securely on the ground and make sure that bystanders are well clear of the nozzle outlet;
- Pump the primer bulb up to 5 times, even if the bulb is full of fuel (Figure 15-4);

Figure 15-4: Location of the primer bulb
» Make sure you have a firm footing: Hold the unit with your left hand on the housing and put one foot against the base plate to prevent it slipping (Figure 15-5);

Figure 15-5: Starting the unit securely on the ground

» Pull the starter grip slowly with your right hand until you feel it engage and then give it a brisk strong pull. Do not pull out the starter rope to full length – it might otherwise break;
» Do not let the starter grip snap back. Guide it slowly back into the housing so that the starter rope can rewind properly;
» Crank the engine until it begins to fire. At this point the machine may run or die, either blip the throttle to remove unit from full choke or turn the choke to half and continue cranking until it fires then blip the throttle to have the machine idle (Figure 15-6).

Figure 15-6: The location of the full choke switch (full) on the blower unit (a), the half choke switch (b) and on the location of the switch on blower handle (c)
If the engine is cold:

» Turn the choke knob (full) (Figure 15-6 a);
» Continue cranking until the engine runs.

If the engine is warm:

» Turn the choke knob to half (Figure 15-6 a);
» Continue cranking until the engine runs;
» As soon as the engine runs return engine to idle speed, operate the throttle trigger and the choke knob will automatically move to the run position.

15.4.3 Refuelling

Refuelling should be done in an area that has been cleared of debris to prevent accidental fire. Do not smoke while refuelling. More details on refuelling can be found in Section 16.2.

When filling up with fuel take care not to spill fuel while fuelling and do not overfill the tank. It is recommended to use specialised filler nozzles from the unit manufacturer.

15.5 Operating the blower

The blower is designed for single-handed operation with the right hand on the control handle. It should be carried as a backpack with the straps of the harness over both shoulders. Wrap the fingers tightly around the handle, keeping the control handle cradled between the thumb and forefinger. Keep the hand in this position to have the machine under control at all times.

15.6 Operating the blower productively

Work methodology and planning ensure that the blower will be used productively. Firstly, be aware of the following environmental conditions:

» Slope: Caution is to be exercised on steep slippery slopes. It is preferable to work up the slope where conditions are very steep.
» Rocky areas: Caution is to be exercised as there is a danger of tripping over unseen rocks in thick vegetation.

The operator should be aware of and practice the following:

» The correct equipment must always be selected for the task; this significantly reduces risk and improves productivity;
» Ensure sound footing and a stable posture;
» The operator should be aware of wind direction and strength at all times, never approach a fire from the front, try to approach from the sides or through the previously burnt area working the fire back into the burnt area or attempt to extinguish the flames.
» A fire management blower should only be used on a cold fire and should never replace water; the blower is only suitable to be used where a beater would have been effective previously.
» Delays should be avoided by ensuring the following:
  • Sufficient fuel is available;
  • Plan refuelling so as to avoid walking long distances to refuel.
15.7 Attachments

Only use and fit attachments like nozzles that are designed for the unit. If the attachments are damaged discard them immediately.

15.8 Drive mechanism

Refer to the operator’s manual with regard to the blower mechanism and maintenance.
16. General outdoor power equipment maintenance

Maintenance is essential to prolong the life of the outdoor power equipment, maximise productivity within the prescribed safety standards and to minimise downtime. To maintain is cost effective and to repair when broken is costly.

Whilst specific maintenance requirements may vary between different makes and models, there are certain general guidelines for preventative maintenance that must be followed.

Maintenance intervals should be shortened in extreme working conditions.

Always consult the owner’s manual for specific requirements. Only maintenance that is to be performed by the outdoor power equipment operator is included in this Chapter.

16.1 Safety requirements

The following safety requirements must be adhered to during maintenance:

» Always shut down the engine and ensure that the moving parts have stopped before attempting any work;
» Do not attempt any work you are not qualified to do;
» Never test the ignition system with the ignition wire terminal removed from the spark plug or with an unearthed spark plug, since uncontained sparking will damage the electronic ignition and may cause fire;
» Use only safe areas for maintenance;
» Comply with the requirements for refuelling. (Refer to Chapter 16.2).

16.2 Refuelling

The following must be adhered to when refuelling:

» Do not refuel with the engine running;
» Use only fuel and lubricants recommended by the manufacturer;
» Do not smoke whilst refuelling;
» Keep the fuel clean at all times;
» Keep a fire extinguisher available at a demarcated area;
» If the use of 2-stroke fuel is required, mix the fuel oil ratio as per manufacturer’s recommendation;
» Remove all flammable debris such as needles or leaves, leaving a small area of ±1 m² exposing bare soil. Thus, refuel in a safe place and guard against fire hazards;
» Use a combi-can or fuel container with a suitable spout to avoid spillage during refuelling (a non-spill combi-can is preferable) (Figure 16-1). All fuel holders must be made from static electric resistant material.
Clean the filler caps and the area around them to ensure that no dirt falls into the tank;  
Remove the fuel filler cap carefully to allow any pressure build-up in the tank to release slowly;  
Shake the mixture thoroughly before refuelling;  
When using a pole saw refill the chain lubrication tank first to the required level (irrespective of the level of the chain lubricant) before refuelling commences. Then refill the fuel tank to the required level. This will ensure that refilling the chain lubrication tank is not forgotten;  
Tighten filler caps securely, taking care not to cross thread;  
Wipe any accidental spillage off the outdoor power equipment and allow time for spilled fuel to evaporate before starting;  
Do not start the outdoor power equipment where it was refuelled. Move at least 3m away from the place of refuelling. Start the outdoor power equipment only once refuelling and other checks have been completed;  
Leave the refuelling canister in a safe area after refuelling.
16.3 Maintenance

Outdoor power equipment maintenance ensures safe and productive use.

16.3.1 Pre-operational checks

To ensure safe and efficient operating of the outdoor power equipment, it is imperative that the operator checks the following before work commences:

» Inspect the complete machine visually to ensure that it is in a serviceable condition;
» Check the operation of machine brakes;
» Check the safety devices.

16.3.2 Ongoing maintenance

The outdoor power equipment operator must monitor the general machine performance throughout the operation. If a decrease in performance is detected it should immediately be attended to and/or reported.

During each refuelling stop or battery change it is recommended that the outdoor power equipment operator does the following:

» Inspect the complete machine visually to ensure that it is in a serviceable condition. Inspect the machine for loose or missing screws, clogged air intake vents and loose covers;
» Check the operation of the throttle trigger, throttle lockout and on/off switch;
» Inspect and sharpen the saw chain (if applicable);
» Refuel the outdoor power equipment.

16.3.3 Daily maintenance

At the end of each working day the outdoor power equipment operator must perform a simple but most important daily service. The importance of the daily service is that during this service small problems may be detected and rectified before they turn into larger problems.

Guidelines for a daily service are as follows:

» Clean the outdoor power equipment and accessible components. Ensure that all air intake areas are clean. A dry clean using compressed air is preferable;
» Check all safety features for damage and effective functioning:
  • Safety devices;
  • Muffler;
  • On/off switch;
  • Throttle lockout and control trigger;
  • Anti-vibration system (Figure 16-2);
Figure 16-2: The anti-vibration system isolates the engine and cutting part of the unit from the operator’s handle

- The spark arrestor (Figure 16-3).

Figure 16-3: Check that the spark arrestor is not blocked or damaged, this part is usually found outside the muffler

- Check and clean/replace the air filter as per the manufacturer’s requirements;
- Clean the carburettor chamber (Figure 16-4);

Figure 16-4: Make sure the carburettor chamber is clear of debris and dust, also make sure the throttle cable is not damaged

- Check the spark plug for clogging, replace the spark plug as per manufacturers specifications and ensure the ‘gap’ is at specification (Figure 16-5);
Check the spark plug for clogging and corrosion

» Check the attachment bevel gear oil level (clearing saws, mulchers and brush cutters) (Figure 16-6);

Figure 16-5: Check the spark plug for clogging and corrosion

Figure 16-6: The oil level of the bevel gear (if applicable) should be checked and topped up if need be.

» Check the starter grip and starter cord for wear, damage and functioning.
» Clean the air intake slots (where applicable) on the starter cover (Figure 16-7);

Figure 16-6: The oil level of the bevel gear (if applicable) should be checked and topped up if need be.

Figure 16-7: Checking the starter cord and the air intakes

» Start the machine and do the standard field test by checking:
» Starting ability – easy starting;
» Idle ability;
» Acceleration response – should be instantaneous;

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» On/off switch function;
» Remove the cutting attachment for storage where applicable;
» Ensure that fuel and chain lubrication tanks are full.

The daily service takes approximately 20-40 minutes to perform, and ensures a functional and reliable unit for the following day's task. Any faults should be reported to the outdoor power equipment mechanic or supervisor and be attended to.

16.3.4 Operation in burnt conditions

Operating in burnt conditions is classed as an adverse application whereby no outdoor power equipment has been purposely built for or designed to handle effectively. This type of application is not the norm and it is obvious that efficiency levels, productivity levels and running costs, will be somewhat adversely affected compared to a non-burnt conditions application. Working in burnt conditions can increase the wear and tear on the components by up to 50%.

The carbon (charcoal) on timber that has been burnt is extremely brittle and when cutting attachments strike this carbon it shatters it into minute dust particles. These fine particles stay suspended in the air around the power tools for some time. This carbon dust is also exceptionally abrasive.

There are certain measures that can be taken in an attempt to minimise the damage that will be caused by the "charcoal" when it comes into contact with the engines' components and other moving parts:

1. **Air Filtration** - A standard felt or flock air filter is made of material that will block particles larger than 30 microns in size. It is almost impossible to prevent the fine carbon dust, together with other impurities that are already in the air, being drawn into a machine's air intake system. Air filtration can be improved by using a:
   a. **Filter Sock** - A filter sock made from selected density foam can be used over the existing air filter as a pre-filter. These are high maintenance components and careful monitoring is required. Improving the effectiveness of these components can be done by:
      • Lightly oiling the filter sock or pre-filter with an air filter oil to improve its filtration ability. This can also be done on the short term by soaking the pre-filter in a bit of fuel mix then squeezing the excess fuel;
      • As soon as there is a noted loss of power or performance of the engine, the pre-filter is likely blocked. The pre-filter should be changed or thoroughly cleaned before being replaced. This may occur many times a day, and a stock of filters is recommended to keep down time low.
   b. **HD (Heavy Duty) Filter** - A heavy duty filter is available for some equipment types and models. These filters have a larger filter surface area which helps by extending change intervals. A filter sock should be used in conjunction with the HD filter.

2. **Refuelling Contaminants** - Refuelling contaminants entering the fuel tank can either pass through or block the fuel filter. Carbon entering the carburettor will increase/speed up the wear to the carburettor components. If the fuel filter gets blocked, the engine will run lean as the air/fuel relationship will be affected and cause component failure. Preventive measures that should be taken include:
   a. Ensuring the refuelling zone is properly cleared out;
b. Wipe or brush dirt from the fuel filler cap before loosening the cap;
c. Using fuel containers with a specialised non spill fuel spout that reduce the possibility of washing dirt into the fuel tank.

3. **Engine Lubrication** - It is impossible to completely eliminate carbon getting into the engine. A good quality 2-stroke oil (synthetic or semi-synthetic) can be used to help improve lubrication under these adverse conditions thus reducing the working heat range of the internal components.

4. **General Maintenance** - Allowing as much air as possible to flow over the cylinder will help prevent over heating of the engine. Components requiring special attention are:
   a. Air Intake. The vents on the starter housing must be kept free of wood shavings and dirt to allow air into the flywheel area;
   b. Flywheel. The fins on fly wheel blow cool air over the cylinder. Air flow is reduced when these become dirty;
   c. The Cylinder Cooling Fins. These must be kept clear and clean of any dirt. Dirt will act as a heat insulator and will cause the engine temperature to rise. Keeping the fins clean will help prevent overheating of the engine.

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**Warranty**

Small powered hand tools are not designed to effectively operate in burnt conditions. If all preventative maintenance measures are adhered to, it will certainly increase the components life to some degree but please note that the components will also wear prematurely from what is normally realised.

It is unlikely that any supplier will warranty a machine/tool when used to harvest/cut burnt timber.
17. References


Husqvarna performance series. 20xx. Working with a Clearing saw – Manual for safe and effective forestry clearing saw use. Husqvarna, Sweden